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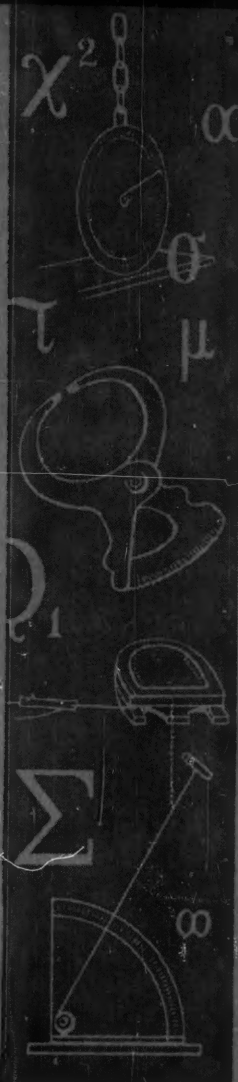

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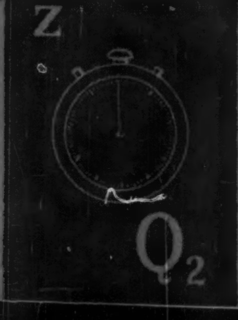

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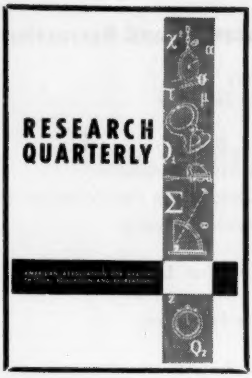

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Effects of Progressive Resistive Exercises on the Motor Coordination of Boys[1]

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Abstract

A study was undertaken to investigate the effects of a program of progressive resistive exercises in the form of weight training on the motor co-ordination of high school boys. An experimental group participated in weight training exercises for four months. During this period, a control group participated in a general program of physical education. All subjects were administered tests of motor co-ordination in the pre- and post-experimental period. At the conclusion of the experimental period, a statistical analysis of the data indicated that the experimental group improved in motor co-ordination more significantly statistically than did the control group. This increase in motor co-ordination was apparently associated with increased anthropometrical and strength measurements caused by the progressive resistive exercise program.

THE SUBJECT of weight training is a controversial one. Many physical educators believe that weight training is worthless because it makes participants "muscle bound,"[2] puts muscles in a permanent state of partial contraction, limits agility, reduces speed, hinders the learning of sport skills, causes undue strain on the body, and is useless specialization. Conversely, there are many others who believe weight training is a worth-while sport, can improve one's proficiency in most other sports, and develops physical fitness. Irrespective of which point of view is taken, one cannot deny that weight training is becoming increasingly popular and widespread. Many of the leading universities and numerous high schools are using weight training as a conditioner for other sports. Notre Dame University, Iowa University, University of California, Louisiana State University, Ohio State University, New York University, and the University of Maryland are a few of the pioneers in this movement.

It is generally agreed and accepted that muscles increase in size through weight training, that strength is increased, that chemical changes take place, and to some extent, perhaps, that the speed of muscular contraction is in-

[1]Thesis submitted to the faculty of the Graduate School of the University of Maryland in partial fulfillment of the requirements for the degree of Doctor of Education. The degree was conferred in June, 1958. The adviser for this study was Dr. Benjamin H. Massey, University of Maryland.

[2]The term "weight training" generally denotes a routine of calisthenics performed with barbells and dumbbells. "Muscle bound" or muscle tightness is a vague term, and usually denotes a short bulky muscle.

creased. However, it is still very much a matter of conjecture whether or not changes in motor co-ordination accompany changes in musculature due to continuous heavy resistive work or exercise. It is entirely possible that motor co-ordination is affected when muscles hypertrophy as the result of heavy resistive work. Obviously, this information is important to physical educators because it will determine in part their attitude toward weight lifting as a sport and toward the use of heavy resistive exercises as a means of conditioning.

The purpose of this study, then, was to investigate the effects of a progressive resistive exercise program, engaged in over a period of four months, on the motor co-ordination of a group of high school boys, ranging in age from fourteen to eighteen years. The exercise program was in the form of weight training with emphasis upon the upper body. An effort was made to determine the effects of the weight training program on speed of movement, as indicated by a basketball wall-bounce test; on accuracy, as indicated by the throwing of a baseball at a target; and on arm-hand dexterity, as indicated by the Minnesota Rate of Manipulation Tests (16).

Review of the Literature

Workers in the fields of physical medicine, therapeutics, and rehabilitation have made various contributions showing the values of weight training in the development of muscular strength and the restoration of lost muscle power. Most of these contributions are in the form of professional experiences and testimonials based on clinical experience rather than scientific research—DeLorme (7), Davis (6), Anderson (1), Hoag (11), and DeLorme and Watkins (8).

Various investigations have been reported which seem to indicate that there is a high relationship between progressive resistive exercises in the form of weight training and increased muscular power and strength—Brodt (2), Capen (4), Chui (5), Masley, Hairabedian, and Donaldson (12), and Meisel (14). Other researchers have reported that weight training does not slow the speed of muscular contraction as was earlier assumed, Capen (4), Zorbas and Karpovich (17), Hairabedian (10), and Wilkins (15).

Massey and Chaudet (13) concluded that weight training, when properly conducted, did not have a detrimental effect upon the range of joint movement throughout the body. Donaldson (9) reported improvement in fencing skills after a period of weight training. Buckiewicz (3) found a significantly greater improvement by an experimental group of weight trainees over a nonweight lifting control group in scores on four fine motor skill tests. Masley, Hairabedian, and Donaldson (12) reported that increased strength gained through training with weights was apparently associated with increased muscular co-ordination and speed of movement.

Subjects

Two groups of high school boys, aged 14 to 18 years, were selected. The weight training group or experimental group (N–20) was designated as

Group A. Each member of Group A was required to obtain a partner who matched him in height, weight, and age. These partners became the control group, Group B (N–20). In anticipation of drop-outs, 31 boys were permitted to volunteer for the experimental group and bring a matching partner for the control group. By the start of the experimental period, the number reduced to 20 matched pairs. In addition to matching on age, height, and weight, further proof of the similarity between the groups was ascertained through a comparison of selected anthropometrical and strength measurements prior to the start of the experimental period. These were left and right biceps girth, left and right forearm girth, chest girth, deltoid width (shoulder width), and left and right grip strength. A statistical analysis of these measurements indicated further evidence of equivalence between the two groups (Table 1). These last measures were obtained not only to demonstrate the physical similarities between the two groups but also to serve in the experiment as indicators of effect weight training had on the musculature.

Tests of Motor Coordination

1. A basketball wall-bounce test was used to measure speed of arm movement. A restraining line was drawn 10 ft. in front of a blank wall. At the starting signal, a stop-watch was started and the subject threw the ball at the wall from behind the restraining line. As the ball returned, he caught it again and bounced it against the wall. This continued until the ball was caught for the tenth time, at which instant the watch was stopped. This test was scored in tenths of seconds. During the pre-experimental period, the researcher conducted reliability checks of this test on two separate practice testing groups (N–30 and N–58). All of these practice subjects were boys from regular physical education classes, who ranged in age from 14 to 18 years. Test results obtained on two different days were correlated using Pierson Product-Moment Procedure. Correlation coefficients of .92 were obtained for both groups.

2. A baseball target test was used to measure accuracy of movement. A concentric circle target, with circles of 1, 2, 3, 4, and 5 ft. in diameter painted on canvas was hung on the backdrop of an enclosed golf net area, with the center 3½ ft. above the ground. The subjects threw ten different regulation baseballs at this target from a distance of 30 ft. All throws were made with both feet behind the 30-ft. restraining line. Scoring was set at five points for the center, four points for the second circle, three points for the third circle, two points for the fourth circle, one point for the fifth circle, and zero points for off the target. The scores for the hits were recorded and totaled. During the pre-experimental period, the researcher conducted reliability checks of this test on the same two practice testing groups used for the basketball wall-bounce test. Correlation coefficients of .88 and .85 were obtained.

3. The Minnesota Rate of Manipulation Placing Test was used to measure arm dexterity, and the Minnesota Rate of Manipulation Turning Test was used to measure hand and finger dexterity (16). The Minnesota Test mate-

TABLE 1.—STATISTICAL EQUATING OF THE EXPERIMENTAL GROUP (GROUP A, N–20) AND THE CONTROL GROUP (GROUP B, N–20) BASED UPON MEASUREMENTS OBTAINED IN THE PRE-EXPERIMENTAL PERIOD

		GROUP A (N–20)			GROUP B (N–20)						
Item	Units	$\overline{X}$	σ^2	σm^2	$\overline{X}$	σ^2	σm^2	t	S.L.[a]	F	S.L.[b]
Left Biceps	mm.	289.35	1389	69	291.90	1076	54	.23	—	1.29	—
Right Biceps	mm.	296.50	1377	68	297.00	1137	57	.04	—	1.21	—
Left Forearm	mm.	253.25	537	27	253.80	719	36	.07	—	1.31	—
Right Forearm	mm.	262.00	756	38	258.65	557	28	.41	—	1.36	—
Chest Girth	mm.	919.85	7881	394	926.95	7035	352	.22	—	1.12	—
Deltoid Width	mm.	391.95	1197	60	404.80	1176	59	1.18	—	1.02	—
Left Grip Strength	kgs.	38.05	80	4	37.50	99	5	.18	—	1.24	—
Right Grip Strength	kgs.	42.05	98	5	41.40	157	8	.18	—	1.60	—
Basketball Wall-Bounce Test	.1 secs.	134.90	1144	57	127.00	804	40	.80	—	1.42	—
Baseball Target Test	points	30.90	89	4	32.75	46	2	.75	—	1.91	—
Minnesota Rate of Manipulation Placing Test	secs.	237.00	506	25	231.65	390	19	.80	—	1.29	—
Minnesota Rate of Manipulation Turning Test	secs.	191.45	730	37	180.65	397	20	1.44	—	1.84	—

[a] Significance at 5 percent level of confidence for 19 degrees of freedom = 2.09.
[b] Significance at 5 percent level of confidence for 19 degrees of freedom = 2.15.

rials consist of a board and discs. The board measures 10 x 35 in. and is pierced with holes in which the discs, 1½ in. in diameter and slightly thicker than the board, are placed or turned. Two tests of the Minnesota Battery were selected—the placing test and the turning test. When administering a test, one practice trial was allowed to each subject. Immediately following the practice trial, the subject was timed for four consecutive separate test trials. The number of seconds required to complete these four test trials was totaled to obtain a composite score. Various reports of the reliability of these standardized Minnesota Tests in extensive situations show reliability coefficients ranging from .92 to .96. However, the researcher conducted further reliability checks during the pre-experimental period on one of his practice testing groups (N–30). An *r* of .91 was obtained for the placing test, and an *r* of .87 was obtained for the turning test.

Description of the Experiment

The experimental group trained with weights for four months, three times per week, one hour per session. During this experimental period, the control group participated in general physical education activities for the same amount of time in the high school where both groups were students. The entire experiment consisted of the following four phases.

1. *The Pre-experimental Phase.* Prior to the actual collection of data, the researcher practiced measurement and testing procedures and established test reliabilities on practice testing groups.

2. *The First Testing Phase.* Initial measurements and test scores were obtained from both the experimental and control groups just prior to the start of the experimental period. Each experimental subject (Group A) brought his partner from the control group (Group B) on three separate days for measurement and testing. On the first day, the anthropometrical and strength measurements were obtained. Readings for the anthropometrical measurements (in centimeters) were repeated until a constant measure was obtained. For the strength measurement, the best of two squeezes on a hand dynamometer (calibrated in kilograms) was accepted for grip strength.

On the second day, the basketball wall-bounce test and the baseball target test were administered. Each subject was allowed to perform these tests twice in succession. In most cases the second attempt was an improvement over the first. The first attempt was considered as practice and warm-up. However, the best score of the two attempts was accepted as the measure for recording, as in several cases the second attempt was not an improvement. On the third day, the Minnesota Rate of Manipulation Placing Test and the Minnesota Rate of Manipulation Turning Test were administered.

3. *The Experimental Period.* The experimental period lasted for four months, during which time the experimental group engaged in a weight training program and the control group engaged in a general program of physical education. The weight trainees were excused from the regular physical education program, and the control subjects did not participate in any weight

TABLE 2.—SIGNIFICANCE OF THE MEAN CHANGES (t-RATIOS) FOR THE EXPERIMENTAL GROUP (GROUP A, N-20) AS A RESULT OF THE EXPERIMENTAL PERIOD

Item	Units	Mean (Pre-exp.)	Mean (Post-exp.)	Mean Diff.	t-Ratio	S.L.[a]
Left Biceps	mm.	289.35	302.80	13.45	5.40	.01
Right Biceps	mm.	296.50	311.25	14.75	7.80	.01
Left Forearm	mm.	253.25	264.90	11.65	7.50	.01
Right Forearm	mm.	262.00	276.70	14.70	7.60	.01
Chest Girth	mm.	919.85	936.90	17.05	3.60	.01
Deltoid Width	mm.	391.95	429.80	37.85	9.20	.01
Left Grip Strength	kgs.	38.05	42.75	4.70	3.13	.01
Right Grip Strength	kgs.	42.05	48.55	6.50	6.20	.01
Basketball Wall-Bounce Test	.1 sec.	134.90	113.50	—21.40	4.40	.01
Baseball Target Test	points	30.90	35.30	4.40	3.22	.01
Minnesota Rate of Manipulation Placing Test	sec.	237.00	220.75	—16.25	5.39	.01
Minnesota Rate of Manipulation Turning Test	sec.	191.45	166.10	—25.35	6.22	.01

[a] Significance at 5 percent level of confidence for 19 degrees of freedom = 2.093.
[b] Significance at 1 percent level of confidence for 19 degrees of freedom = 2.861.

training during this period. The regular program of physical education consisted of calisthenics, track events, sports fundamentals, swimming, and games (volleyball, lacrosse, basketball, softball, and touch football).

4. *The Second Testing Phase.* At the conclusion of the experimental period the anthropometrical and strength measurements used in the first testing phase were again obtained, and the tests of motor co-ordination were again administered to the experimental and control groups. Exactly the same procedures which were used in the first testing phase to obtain measurements and test scores were repeated in this second testing phase.

Statistical Analysis of the Data

The t-ratio was used to discover if the mean change for each group during the experimental period was statistically significant. The formula based on matched pairs was used

$$t - \frac{Md}{\sigma md} \text{ (Tables 2 and 3).}$$

The significance of the differences between the mean changes for the experi-

TABLE 3.—SIGNIFICANCE OF THE MEAN CHANGES (t-RATIOS) FOR THE CONTROL GROUP (GROUP B, N–20) AS A RESULT OF THE EXPERIMENTAL PERIOD

Item	Units	Mean (Pre-exp.)	Mean (Post-exp.)	Mean Diff.	t-Ratio	S.L.[a]
Left Biceps	mm.	291.90	298.40	6.50	2.74	.05
Right Biceps	mm.	297.00	302.80	5.75	3.30	.01
Left Forearm	mm.	253.80	261.00	7.20	3.20	.01
Right Forearm	mm.	258.65	267.60	8.95	5.20	.01
Chest Girth	mm.	926.95	931.55	4.60	1.09	—
Deltoid Width	mm.	404.80	420.20	15.40	4.60	.01
Left Grip Strength	kgs.	37.50	41.65	4.10	4.60	.01
Right Grip Strength	kgs.	41.40	45.20	3.80	3.16	.01
Basketball Wall-Bounce Test	.1 sec.	127.00	118.90	–8.10	2.23	.05
Baseball Target Test	points	32.75	34.70	1.95	1.87	—
Minnesota Rate of Manipulation Placing Test	sec.	231.65	220.85	–10.80	3.80	.01
Minnesota Rate of Manipulation Turning Test	sec.	180.65	159.80	–20.85	6.50	.01

[a] Significance at 5 percent level of confidence for 19 degrees of freedom = 2.093.
[b] Significance at 1 percent level of confidence for 19 degrees of freedom = 2.861.

mental and control groups as a result of the experimental period was evaluated in terms of t-ratios based on the formula for independent groups

$$t - \frac{Mx - Mc = Md}{\sqrt{\sigma mx^2 + \sigma mc^2}} \text{ (Table 4).}$$

F-ratios were computed for those variables which showed statistically significant t-ratios at the 5 percent level of confidence or better (Table 5).

Findings

1. The experimental group made statistically significant gains in all of the selected anthropometrical and strength measurements at the 1 percent level of confidence. The group also made statistically significant gains in all four of the tests of motor co-ordination at the 1 percent level of confidence (Table 2).

2. The control group made statistically significant gains in four of the six selected anthropometrical measurements at the 1 percent level of confidence. These were right biceps, left forearm, right forearm, and deltoid width. The

TABLE 4.—SIGNIFICANCE OF THE DIFFERENCES (t-RATIOS) BETWEEN THE MEAN CHANGES FOR THE EXPERIMENTAL GROUP (GROUP A) AND THE CONTROL GROUP (GROUP B) AS A RESULT OF THE EXPERIMENTAL PERIOD

		GROUP A (N–20)					GROUP B (N–20)								
Item	Units	$\overline{X}c$ Exp	σc Exp	σmd Exp	t-Exp	S.L.[a] 19 DF	$\overline{X}c$ Cont	σc Cont	σmd Cont	t-Cont	S.L.[a] 19 DF	$\overline{X}$ Diff Change	σmd Change	t-Ratio	S.L.[b] 38 DF
Left Biceps	mm.	13.45	11.09	2.48	5.40	.01	6.50	10.63	2.37	2.74	.05	6.95	3.50	1.98	.10
Right Biceps	mm.	14.75	8.36	1.87	7.80	.01	5.75	7.81	1.74	3.30	.01	9.00	2.55	3.55	.01
Left Forearm	mm.	11.65	6.92	1.55	7.50	.01	7.20	10.00	2.23	3.32	.01	4.45	2.71	1.64	.10
Right Forearm	mm.	14.70	8.66	1.93	7.60	.01	8.95	7.61	1.70	5.20	.01	5.75	2.57	2.23	.05
Chest Girth	mm.	17.05	20.77	4.64	3.60	.01	4.10	18.70	4.18	.98	—	12.95	6.24	1.99	.10
Deltoid Width	mm.	37.85	18.41	4.10	9.20	.01	15.40	14.76	3.30	4.60	.01	22.45	5.29	4.24	.01
Left Grip Strength	kgs.	4.70	6.78	1.50	3.13	.01	4.10	4.00	.89	4.60	.01	.60	1.73	.34	.80
Right Grip Strength	kgs.	6.50	4.69	1.04	6.20	.01	3.80	5.47	1.20	3.16	.01	2.70	1.59	1.69	.10
Basketball Wall-Bounce Test	.1 secs.	–21.40	21.74	4.86	4.40	.01	–8.10	14.17	3.17	2.23	.05	13.30	5.80	2.29	.05
Baseball Target Test	points	4.40	6.08	1.36	3.22	.01	1.95	4.69	1.04	1.87	—	2.45	1.72	1.42	.20
Minnesota Rate of Manipulation Placing Test	secs.	–16.25	13.49	3.01	5.39	.01	–10.80	12.68	2.83	3.80	.01	5.45	4.12	1.30	.20
Minnesota Rate of Manipulation Turning Test	secs.	–25.35	17.49	3.91	6.22	.01	–20.85	14.35	3.20	6.50	.01	4.50	5.06	.88	.40

[a] Significance at 5 percent level of confidence for 19 degrees of freedom = 2.093.
Significance at 1 percent level of confidence for 19 degrees of freedom = 2.861.

[b] The significant levels of confidence are based upon R. A. Fisher's Table of t-Ratios, where significant levels for small samples are worked out beyond the one percent and five percent levels of confidence. Using one set of statistics, Fisher allows N–1 (20-1) or 19 degrees of freedom. However, only the generally acceptable five percent or one percent levels of confidence were considered for the conclusions of this experiment.
Significance at 5 percent level of confidence for 38 degrees of freedom = 2.025.
Significance at 1 percent level of confidence for 38 degrees of freedom = 2.711.

TABLE 5.—SIGNIFICANCES OF THE DIFFERENCES IN VARIANCE (F-RATIOS) FOR SELECTED VARIABLES SHOWING SIGNIFICANT t-RATIOS AT THE CONCLUSION OF THE EXPERIMENTAL PERIOD

Item	t-Ratio[a]	S.L. 38 DF	Variance[b] Exp. Group	Variance[b] Cont. Group	F-Ratio	S.L.[c] 38 DF
Right Biceps	3.55	.01	70	61	1.14	—
Right Forearm	2.23	.05	75	58	1.29	—
Deltoid Width	4.24	.01	339	218	1.50	—
Basketball Wall-Bounce Test	2.29	.05	473	201	2.35	.05

[a] The t-ratios represent statistically significant gains of the experimental group over the control group as indicated at the conclusion of the experimental period.
[b] Variances were calculated for each item which showed a significant t-ratio at the 1 percent or 5 percent level of confidence.
[c] Significance at 5 percent level of confidence for 38 degrees of freedom = 2.15.

exceptions were for left biceps in which a statistically significant gain was made at the 5 percent level of confidence and for chest girth in which there was not a statistically significant gain at the 5 percent level of confidence ($t = .98$). This group also made statistically significant gains in both of the selected strength variables at the 1 percent level of confidence. Statistically significant gains were made in two of the four tests of motor co-ordination at the 1 percent level of confidence. These were the Minnesota Rate of Manipulation Placing Test and the Minnesota Rate of Manipulation Turning Test. This group made a statistically significant gain in the basketball wall-bounce test at the 5 percent level of confidence and did not make a statistically significant gain in the baseball target test at the 5 percent level of confidence ($t = 1.87$) (Table 3).

3. The comparison of the mean changes for the two groups showed that in the six selected anthropometrical measurements of the upper body, the experimental group showed greater gains than did the control group.

4. The comparison of the mean changes for the two groups showed that in left and right grip strength there were no statistically significant differences between the statistically significant gains made by both groups.

5. In the basketball wall-bounce test, the experimental group gained more than the control group at the 5 percent level of confidence.

6. The experimental group gained more than the control group in the baseball target test. The difference was not significant at the 5 percent level of confidence. However, it approached significance with a t-ratio of 1.42 at the 20 percent level of confidence.

7. The experimental group gained more than the control group in the Minnesota Rate of Manipulation Placing Test. The difference was not significant at the 5 percent level of confidence. However, it approached significance with a t-ratio of 1.30 at the 20 percent level of confidence.

8. The control group gained more than the experimental group in the Minnesota Rate of Manipulation Turning Test. However, the difference did not approach significance.

Discussion

The initial comparison of means and mean differences as found in the second testing phase showed that both the experimental and control groups had made gains in all of the 12 selected variables, although not all of the gains made by the control group were statistically significant. It was assumed that a portion of the increase in anthropometrical measurements was due to growth, that the increase in strength measurements was partly due to a natural increase in strength, and that the improvement in test scores of motor co-ordination was due to the former experience in the first testing phase, plus possibly a natural bodily increase in motor co-ordination. The amount of improvement due to the regular physical education program of the control group, and the weight training program of the experimental group, became a continuing question. The comparison of mean difference gains or losses were further analyzed (Table 4).

The statistically significant gain in deltoid width for the experimental group beyond that of the control group may possibly permit an observer to infer with reasonable assurance that weight training increases shoulder width and therefore produces "broad shoulders."

In the basketball wall-bounce test there was a significant difference in variance at the 5 percent level of confidence, with the experimental group showing the greater variance (Table 5). It is suggested that the skill involved in chest-passing a basketball is similar to the skill involved in pushing up weights. The basketball chest-pass is often referred to as the push-pass. It is conceivable that the increased strength obtained by the weight trainees as a result of the experimental period helped them to improve more than the control group in the basketball wall-bounce test.

In the baseball target test, the researcher points out that the weight trainees did not participate in any ball playing, whereas the nonweight trainees did play basketball, softball, and touch football during the experimental period. Yet, the experimental group made a greater gain in this element of motor co-ordination.

It seems worthy of note that the experimental group made the greater improvement in the Minnesota Rate of Manipulation Placing Test, although not statistically significant, and the control group made the greater improvement in the turning test, although not statistically significant. Possibly, further investigation extended over a longer period of time may indicate that weight training helps an individual better to perform activities involving arm movements, but hinders one in the performance of fine skills in which the fingers and hands are mainly involved. However, this is merely an assumption.

Summary

An analysis of the gains as shown at the conclusion of the experimental period showed that in the six anthropometrical measurements of the upper body (left biceps, right biceps, left forearm, right forearm, chest girth, and deltoid width), the experimental group showed greater gains over the control

group. In three of these variables (right biceps, right forearm, and deltoid width), the greater gains were statistically significant at the 5 percent level of confidence or better. In the other three selected anthropometrical measurements (left biceps, left forearm, and chest girth), the greater gains of the experimental group over the control group approached significance at the 10 percent level of confidence.

There were no statistically significant differences in strength between the experimental and control groups. Both groups made statistically significant gains at the 1 percent level of confidence. However, in right grip strength the experimental group made a greater gain than did the control group. Although this greater gain was not significant at the 5 percent level of confidence, it approached significance at the 10 percent level of confidence.

The experimental group improved more than the control group in the basketball wall-bounce test at a statistically significant level of confidence (.05). This group also improved more than the control group in the baseball target test and the Minnesota Rate of Manipulation Placing Test. Although these gains were not statistically significant at the 5 percent level of confidence, they approached significance at the 20 percent level of confidence.

The control group did not make any statistically significant gains over the experimental group in any of the selected variables for anthropometrical measurements, strength measurements, or tests of motor co-ordination.

Conclusions

The results of this study gave no indication that muscular development associated with weight training over a four-month period of time had in any way a deleterious effect on the motor co-ordination of a group of high school boys, ranging in age from 14 to 18 years. In fact, the results seem to indicate that progressive resistive exercises in the form of weight training tend to affect favorably the motor co-ordination of high school boys.

Recommendations

There is a definite need for further research on the subject of progressive resistive exercise as related to all aspects of physical fitness, e.g., running speed, agility, flexibility, timing, rhythm, and circulatory efficiency. In addition, there is need for further study relative to motor co-ordination. It is hoped that this study will be duplicated, using a longer experimental period and more or different tests. Possibly, the use of mechanical testing devices or electronic devices could be employed to advantage.

References

1. Anderson, E. R. "Heavy Resistance Low Repetition Exercises in the Restoration of Function in the Knee Joint." *Nova Scotia Medical Bulletin,* December 1946.
2. Brodt, Melvin E. "Changes in Physical Fitness Associated with Weight Lifting." *Urbana Magazine.* University of Illinois, 1950.
3. Buckiewicz, Frank A. "An Experimental Study of the Effects of Weight Training on Fine Motor Skills." Master's Thesis. University Park: Pennsylvania State University, 1954.

4. Capen, Edward K. "The Effect of Systematic Weight Training on Power, Strength and Endurance." *Research Quarterly* 21:2; May 1950.
5. Chui, Edward. "The Effect of Systematic Weight Training on Athletic Power." *Research Quarterly* 21:3; October 1950.
6. Davis, John Eisele. *Rehabilitation—Its Principles and Practice.* New York: A. S. Barnes Company, 1946.
7. DeLorme, Thomas L. "Restoration of Muscle Power by Heavy Resistance Exercises." *Journal of Bone and Joint Surgery,* October 1945.
8. DeLorme, Thomas L., and Watkins, Arthur L. "Technics of Progressive Resistance." *Archives of Physical Medicine,* May 1948.
9. Donaldson, Donald N. "Weight Training in Relation to Strength and Muscular Coordination." Master's Thesis. University Park: Pennsylvania State University, 1952.
10. Hairbedian, Ara. "Weight Training in Relation to Strength and Speed of Movement." Master's Thesis. University Park: Pennsylvania State University, 1952.
11. Hoag, D. C. "Physical Therapy in Orthopedics, With Special References to Heavy Resistance, Low Repetition Exercise Program." *Physiotherapy Review,* November 1946.
12. Masley, John W.; Hairbedian, Ara; and Donaldson, Donald N. "Weight Training in Relation to Strength, Speed and Coordination." *Research Quarterly* 24:3; October 1953.
13. Massey, Benjamin H., and Chaudet, Norman L. "Effects of Systematic, Heavy Resistive Exercise on Range of Joint Movement in Young Males." *Research Quarterly* 27:1; March 1956.
14. Meisel, Stephen Gaylor. "The Effect of a Weight Training Program on the Speed of Running." Master's Thesis. University Park: Pennsylvania State University, 1957.
15. Wilkins, Bruce M. "The Effect of Weight Training on Speed of Movement." *Research Quarterly* 23:3; October 1952.
16. Ziegler, W. A. *Minnesota Rate of Manipulation Test.* Philadelphia: Educational Test Bureau, Inc., 1946.
17. Zorbas, William S., and Karpovich, Peter V. "The Effect of Weight Lifting Upon the Speed of Muscular Contractions." *Research Quarterly* 22:2; May 1951.

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Effects of Training and Conditioning for Middle Distance Swimming upon Various Physical Measures[1]

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Abstract

This study attempts to analyze the effects of training and conditioning for the 200-yard crawl stroke event upon the physical condition of nonvarsity swimmers. Selected measures of cardiovascular condition, general physical fitness, gross strength, motor fitness, strength of the muscle groups primarily utilized in swimming the crawl stroke, and the strength decrements of the involved muscles were taken before and after the experimental period in order to evaluate the effects of this period. In addition, the relationships between speed in swimming the 200-yard crawl stroke event and the various selected tests were studied.

As a result of the training and conditioning program, scores on test batteries used to measure physical fitness, motor fitness, and gross strength improved significantly. No significant difference was obtained for cardiovascular condition. Further, no coefficient of correlation was obtained that was sufficiently high to be of value for prediction of swimming time.

IN RECENT YEARS there has been an increasing interest among physical educators in determining the effects of the various activities of physical education on the students and persons participating in these programs. Too little research has been done, however, to provide adequate knowledge and scientific information. It is of the utmost importance to physical educators and coaches to know the changes that occur in the individual after a season on the athletic field or a course in physical education activity.

A great deal of discussion and philosophical writing has been presented in an effort to establish objectives in physical education, but little has been done to determine just how various activities contribute to those objectives. Most physical educators will agree that good cardiovascular condition, physical fitness, motor fitness, and strength are valuable outcomes of athletic and physical education programs. It is upon this assumption that the present investigation was undertaken.

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[1]This study was completed as a doctoral dissertation at the University of Oregon, under the advisement of H. Harrison Clarke.

Purpose of the Study

The major purpose of this investigation was to study the effects of training and conditioning for the 200-yard crawl stroke event upon the physical condition of nonvarsity swimmers. The aspects of physical condition included in this research were limited to selected measures of the following factors: (a) cardiovascular condition, (b) general physical fitness, (c) gross strength, (d) motor fitness, (e) strength of the muscle groups primarily utilized in swimming the crawl stroke, and (f) the strength decrements of these involved muscles.

As a secondary purpose, the relationships between speed in swimming the 200-yard crawl stroke event and the various selected tests were studied. These relationships were considered in an effort to discover if the test items and batteries were valid predictors of swimming ability either when the participants were unconditioned or when they were conditioned for swimming 200 yards. The participants were considered in an unconditioned state at the first time trial and in a conditioned state at the last time trial.

Few studies are directly related to the present investigation. Only one (7) was found that was concerned primarily with swimming. Several studies have been reported dealing with the effects of participation in various activities upon measures of strength, endurance, physical and motor fitness, and motor ability. These studies indicate that participation in the more vigorous activities, actually conducted on a vigorous scale, produces greater increases in strength and endurance than does participation in less vigorous activities or activities conducted at a less vigorous pace. Since none of these related studies (7, 8, 9, 14) were of the same experimental design as the present investigation, a review will be omitted.

For the most part, the literature shows inadequate evidence of the physical effects resulting from participation in various physical education activities. The present research proposes to produce a more thorough and comprehensive understanding of the results of training and conditioning in *one* physical education activity, namely swimming.

Procedure

The subjects used in this investigation were 30 male students enrolled at the University of Oregon. Selection of subjects was limited to those who could swim at least 200 yards using the crawl stroke but did not have skill comparable to varsity swimmers.

The students volunteered as subjects after being acquainted with the purposes and requirements of the study. Each subject was told that the experiment would be strenuous and exhausting; that he would be expected to make his best all-out efforts in both swimming workouts and the various tests that were to be given; and that maximum co-operation was necessary if the experiment was to be successful. The investigator believes that the 30 subjects completing the conditioning regimen co-operated in every way with all re-

quests made upon them and performed all tests and conditioning workouts to the best of their ability.

Tests designed to measure certain body conditions were utilized in this investigation. The body conditions and the test selected for each were as follows:

1. *Cardiovascular condition:* Schneider Cardiovascular Index (13).
2. *General physical fitness:* Rogers Physical Fitness Index (12).
3. *Gross strength:* Rogers Strength Index (12).
4. *Motor fitness:* Navy Standard Physical Fitness Test (11).
5. *Strength of involved muscle groups:* Clarke's Cable-Tension tests (1) for the following six muscle groups involved in swimming the crawl stroke: shoulder flexion, shoulder extension, hip flexion, hip extension, knee flexion, and knee extension.
6. *Strength loss of involved muscle groups:* Strength Decrement Index (SDI) (2) for the six muscle groups indicated in the preceding paragraph. The formula for the SDI is as follows:

$$\mathrm{SDI} = \frac{S_i - S_f}{S_i} \times 100$$

S_i = Initial strength: taken before the 200-yard swim.
S_f = Final strength: taken immediately after the 200-yard swim.

7. *Individual test items composing the various test batteries:* squat thrusts, sit-ups, squat jumps, chins, dips, push-ups, leg lift, back lift, nondominant grip, arm strength (both McCloy and Rogers formulas), and lung capacity.

The techniques for administering the selected tests may be found in the references given.

The total time required for this investigation was nine weeks, divided into three parts: the pre-experimentation period, which consisted of three weeks; the experimentation period, which consisted of the next five weeks; and the post-experimentation period, which consisted of the last week of the study.

PRE-EXPERIMENTATION PERIOD

During this three-week period, two functions were performed. The selected tests and test batteries were administered to the subjects, and preliminary swimming instruction and an opportunity for swimming practice, especially to become familiar with pace in swimming 200 yards, was provided.

Initial Testing. Every effort was made to administer the tests, listed above, as prescribed by their originators. Only testers who were skilled and experienced in the administration of these tests were used.

Instructional Procedures. During the pre-experimentation period, each subject was acquainted with the requirements of swimming; his skill in stroke techniques, starts, and turns was brought to a fairly constant level; and some knowledge of pace in swimming the 200-yard crawl stroke event was obtained. The head-out, or breathing turn, was used by all subjects in an effort

to maintain consistency. Each subject was required to swim the 200-yard event four times during this period in order to become familiar with the pace that would enable him to swim his fastest time when the recorded time trials were held.

While some conditioning of the subjects must have occurred during this period, it was felt that the first recorded swimming times of the subjects were more indicative of their ability than would have been the case had these unskilled swimmers swam for time during their first appearance in the pool.

EXPERIMENTATION PERIOD

This period of five weeks constituted the training and conditioning phase. The subjects met three times each week; two sessions were training periods and one was the weekly time trial. The workout periods were each at least 45 minutes in length. The sessions were held every other day to provide the subjects a full day of rest between each workout and before each time trial.

Timing Procedures. Time trials for the 200-yard crawl stroke event were held once each week on the last session of the week, with the exception of the first week. The first time trial was held during the first session of the first week, so as to establish each subject's swimming time at the start of the study.

Each subject swam his time trial alone, in competition with his own former time, and was urged constantly to better this time. When it was believed from observation that the subject was not performing at his best, he was stopped and required to swim the event again on another day. National Collegiate Athletic Association swimming rules were followed in all time trials in regard to starting, turning, and timing.

Cable-Tension Strength Testing Procedures. Cable-tension strength tests of the involved muscle groups were taken just before and after the first and last time trials at poolside. As quickly as possible after the completion of the 200-yard swim, each subject was helped from the pool and immediately given the cable-tension tests. Every effort was made to speed up this process in order to reduce to a minimum the strength recovery time of the muscle groups being tested. The order in which the post-swim cable-tension tests were given was rotated in accordance with a Latin-square procedure so that the time for strength recovery was equalized for all muscle groups.

Training and Conditioning Procedures. The two training and conditioning sessions each week consisted of various combinations of pulling, kicking, starts, turns, calisthenics, wind sprints, long distance swimming, and pacing practice. All assignments in both the warm-up and the actual conditioning workouts were performed at the maximum work tolerance level for each subject. Each day's workout was preceded by a warm-up period consisting of the following calisthenics and swimming:

Calisthenic warm-up: (1) double arm circling in both directions, 15-20 repetitions in each direction; (2) full circle trunk rotations with straight legs, 10-15 repetitions in each direction; (3) sit-ups, 10-15 repetitions; (4) chest and shoulder girdle stretcher (with

upper and lower arm at shoulder level, elbow joint completely flexed, hands touching in front of chest, a vigorous movement to the rear), 15-20 repetitions; (5) push-ups, 10-15 repetitions.

Swimming warm-up: (1) 60 yards kicking, (2) 60 yards pulling, and (3) 80 yards crawl stroke.

The following regimen constituted the daily training and conditioning workouts for the entire experimentation period:

FIRST WEEK. *First day:* Recorded (1) 200-yard crawl stroke time trial and (2) cable-tension strength tests before and after swim to obtain initial SDI's; *Second day:* (1) Coaching on pace and breathing techniques, and (2) 200-yard crawl stroke swim; *Third day:* (1) Coaching on stroke and breathing techniques, and (2) 100 yard swim each on kicking, pulling, and the crawl stroke.

SECOND WEEK. *First day:* (1) Coaching on starts and turns, (2) practice starting, and (3) five-minute continuous crawl stroke, pool widths, emphasis on turning. *Second day:* (1) 200 yards kicking, (2) 100 yards pulling, and (3) 160 yards crawl stroke. *Third day:* Recorded 200-yard crawl stroke time trial.

THIRD WEEK. *First day:* (1) Practice on starts and turns, and (2) ten-minute continuous crawl stroke, pool length. *Second day:* (1) ten-minute continuous crawl stroke, pool widths, emphasis on turning, (2) 100 yards kicking, and (3) 20-, 40-, 60-, 40-, and 20-yard full speed crawl stroke wind sprints with a 30-second rest period between each sprint. *Third day:* Recorded 200-yard crawl stroke time trial.

FOURTH WEEK. *First day:* (1) Practice on starts and turns, (2) coaching stroke mechanics, and (3) two 220-yard crawl stroke time trials. *Second day:* (1) Practice on starts and turns, (2) 100 yards each on kicking and pulling, and (3) 20-, 40-, and 20-yard full speed crawl stroke wind sprints with a 30-second rest period between each sprint. *Third day:* Recorded 200-yard crawl stroke time trial.

FIFTH WEEK. *First day:* (1) Coaching and practice of stroke mechanics, and (2) 200-yard crawl stroke time trial. *Second day:* Same as first day. *Third day:* (1) Recorded 200-yard crawl stroke time trial, and (2) cable-tension tests before and after swim to obtain final SDI's.

POST-EXPERIMENTATION PERIOD

During the last week of this investigation, the same test batteries administered in the pre-experimentation period were again given. The testing techniques were the same as previously described.

Analysis of the Data

The results of this investigation are presented in two parts. The first deals with the changes and effects resulting from training and conditioning for the 200-yard crawl stroke event. The second part presents the relationships between swimming time and scores on the various tests and test batteries when the subjects were in unconditioned and conditioned states. No claims are made relative to the degree of conditioning reached during the experimentation period; it is obvious that ultimate conditions may not be achieved in only 15 workout sessions.

CONDITIONING EFFECTS RESULTING FROM THE EXPERIMENTAL PERIOD

In analyzing the effects of conditioning for swimming upon the various items measured, the method described by Dixon and Massey (5) for signifi-

cant differences between means for correlated groups was used. The test means obtained during the pre-experimentation period were compared with the means taken during the post-experimentation period to determine if there were differences resulting from the training and conditioning that could be considered statistically significant. For significance at the .01 level of confidence for 30 cases with N-1 degrees of freedom, a t value of 2.76 is required.

Times for the Two Hundred-Yard Crawl Stroke Event. The progressive effects of training and conditioning upon time in the 200-yard crawl stroke event are shown in Figure I. The improvement in time is almost a straight-line rise. The dotted line shows a rise of only .3 second between the preliminary time trial and the first time trial. This might indicate that there was relative stability in such factors as pace, starts, and turns at the beginning of the experimental period.

The mean decrease in time from the first to the last time trial was 23.7 seconds. The t value for this difference was 7.65, which indicates statistical significance well beyond the .01 level of confidence. The greatest decrease in time occurred between the first and second time trials. This drop, however, measures a two-week period of training and conditioning.

Test Batteries. A comparison of the means of the scores on test batteries obtained before and after the training and conditioning period is presented in Table 1. With the exception of the Schneider Cardiovascular Test, which had a t ratio of only 1.03, all differences between initial and final means were significant well beyond the .01 level.

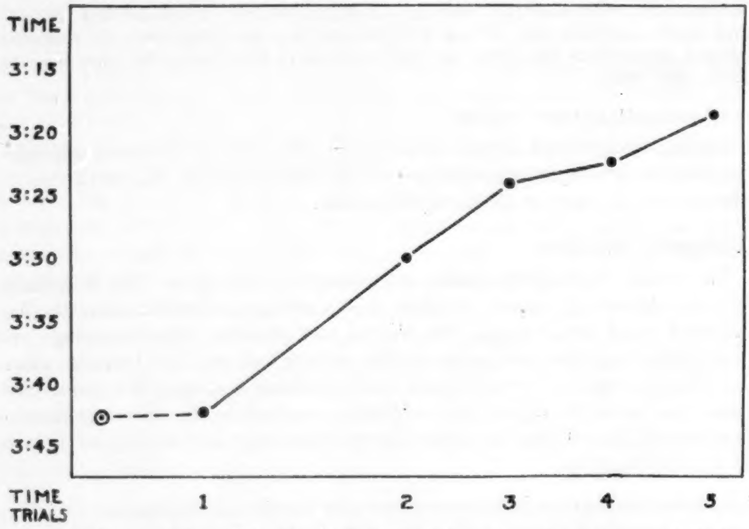

FIGURE I.—Means of the weekly time trials in the 200-yard crawl stroke event, including preliminary time trial.

TABLE 1.—COMPARISON OF THE MEANS OF THE TEST BATTERIES BEFORE AND AFTER TRAINING AND CONDITIONING FOR THE 200-YARD CRAWL STROKE EVENT

Test	Mean Before	Mean After	Differences Between Means	*t*
Rogers Strength Index	2929.50	3336.10	406.60	10.78
Navy Standard Physical Fitness Test	49.02	56.95	7.93	10.43
Rogers Physical Fitness Test	101.43	114.57	13.14	9.52
Schneider Cardiovascular Test	11.77	12.47	0.70	1.03

The differences between the means for the other test batteries were all high, with *t* ratios ranging from 9.52 for the Physical Fitness Index to 10.78 for the Strength Index. The gains from the pre- to the post-experimental scores on these batteries are pronounced. Inasmuch as the scores on the Navy Standard Physical Fitness Test are recorded as T-scores, the gain in means from 49.02 to 56.95 represents approximately .8 standard deviation. The increase in the Physical Fitness Index mean from 101.43 to 114.57 indicates a gain of almost one quartile.

Items Composing the Test Batteries. The means of the scores obtained on the test items of the Rogers Strength Test and the Navy Standard Physical Fitness Test before and after the training and conditioning program are given in Table 2. Also, inasmuch as the data were available, arm strength as determined by McCloy's pull-up formula (10), taken before and after the experimental period, was compared in the hope that further information might be obtained.

The differences between the means before and after the conditioning period for the various test items were all significant, except for grip strength. The

TABLE 2.—COMPARISON OF THE MEANS OF THE TEST ITEMS OF THE ROGERS STRENGTH TEST, McCLOY'S ARM STRENGTH (PULL-UP) AND THE NAVY STANDARD PHYSICAL FITNESS TEST BEFORE AND AFTER TRAINING AND CONDITIONING FOR THE 200-YARD CRAWL STROKE EVENT

Test		Mean Before	Mean After	Differences Between Means	*t*
Arm strength	(Rogers)	575.10	700.20	125.10	11.69
Back lift	(Rogers)	426.33	544.50	118.17	9.12
Squat jumps	(Navy)	38.43	49.10	10.67	8.75
Pull-ups	(Navy)	6.53	7.97	1.44	6.26
Arm strength	(McCloy)	277.40	284.03	6.63	5.02
Sit-ups	(Navy)	70.60	106.53	35.93	4.64
Squat thrust	(Navy)	27.13	29.67	2.54	4.62
Push-ups	(Navy)	24.53	28.63	4.10	4.51
Leg lift	(Rogers)	1365.50	1515.67	150.17	4.12
Lung capacity	(Rogers)	311.03	320.00	8.97	3.72
Grip strength nondominant	(Rogers)	120.27	120.47	0.20	0.11

TABLE 3.—COMPARISON OF THE MEANS OF THE STRENGTH OF THE INVOLVED MUSCLES BEFORE AND AFTER TRAINING AND CONDITIONING FOR THE 200-YARD CRAWL STROKE EVENT

Test	Mean Before	Mean After	Differences Between Means	t
Shoulder flexors	127.45	137.10	9.65	2.77
Shoulder extensors	122.59	134.21	11.62	3.98
Hip flexors	125.40	129.20	3.80	0.82
Hip extensors	148.83	164.43	15.60	1.72
Knee flexors	130.90	134.57	3.67	0.64
Knee extensors	199.23	238.10	38.87	6.94

highest t ratios were for Rogers' arm strength score (11.69), back lift (9.12), and squat jumps (8.75). The other test items showed significant differences beyond the .01 level with t's ranging from 3.72 to 6.26.

Strength of the Involved Muscle Groups. The mean strengths for the involved muscle groups obtained before and after the training and conditioning program are presented in Table 3. The t ratios for the differences between the means for knee extension (6.94), shoulder extension (3.98), and shoulder flexion (2.77) were statistically significant beyond the .01 level of confidence. No significant differences existed for hip flexion, hip extension, and knee flexion.

Strength Decrements of the Involved Muscle Groups. In Table 4 appear the means for the Strength Decrement Indexes taken at the first and last time trials. No differences between SDI's at the first and last time trials were found that could be considered statistically significant. The percentage strength loss of the involved muscle groups as a result of swimming are also shown in this table. Shoulder extensors, shoulder flexors, and hip flexors evidenced the greatest loss on the first time trial. On the last time trial, shoulder extensors, hip extensors, and knee flexors were found to suffer the greatest strength loss.[2]

TABLE 4.—COMPARISON OF THE MEANS FOR THE STRENGTH DECREMENT INDEXES OF THE INVOLVED MUSCLES BEFORE AND AFTER TRAINING AND CONDITIONING FOR THE 200-YARD CRAWL STROKE EVENT

Test	First Time Trial	Last Time Trial	Differences Between Means	t
Shoulder flexors	14.33	11.11	−3.22	0.93
Shoulder extensors	22.23	18.23	−4.00	1.37
Hip flexors	17.63	8.79	−8.84	1.33
Hip extensors	12.04	14.86	2.82	0.54
Knee flexors	12.99	12.46	−0.53	0.10
Knee extensors	6.97	7.54	0.57	0.16
Mean SDI	14.37	12.17	−2.20	0.89

[2]A discussion of strength decrement implications from swimming appears later in this report.

RELATIONSHIPS BETWEEN SWIMMING TIME AND TEST SCORES

Zero-Order Correlations. In further analysis of the data, product-moment coefficients of correlation (6) were computed to determine the relationships between swimming time and the variables included in this study. These correlations were computed separately for the scores obtained during the pre-experimentation period with the times on the first time trial; and for the scores obtained during the post-experimentation period with the times on the last time trial. In each instance, time in the 200-yard crawl stroke event served as the criterion, and the various test batteries, test items of the test batteries, strength of the muscle groups involved, and SDI's of the same muscles constituted the experimental variables. In interpreting the correlations, *r*'s of .361 and .463 are significant at the .05 and .01 levels respectively for 30 cases, with N-2 degrees of freedom (6).

TABLE 5.—CORRELATIONS BETWEEN TIME FOR THE 200-YARD SWIM AND THE TEST BATTERIES

Test	First Time Trial	Last Time Trial
Rogers Strength Index	—.373	—.351
Navy Standard Physical Fitness Test	—.104	—.091
Rogers Physical Fitness Index	—.033	—.063
Schneider Cardiovascular Test	—.074	—.050

Test Batteries. Correlations between times on the first and last time trials and the various test batteries are presented in Table 5. Only the correlation between time on the first swim and scores on the Rogers Strength Index (—.373) is high enough to be considered significant at the .05 level of confidence. The correlation between time on the last time trial and the Rogers Strength Index (—.351) very nearly reached significance at the .05 level. None of the other correlations between swimming on either swim and the test batteries was significant; these correlations were very low, ranging from —.033 to —.104.

Test Items of the Rogers Test, Navy Test, and McCloy's Arm Strength. The correlation coefficients between time in the unconditioned and conditioned states, and the test items of the Rogers Strength Index Test, the Navy Standard Physical Fitness Test, and McCloy's arm strength are presented in Table 6.

Among the test items composing the test batteries, lung capacity had the highest correlation with swimming time for both swims; the correlations were —.581 and —.592 for the first and last time trials respectively. McCloy's arm strength had the next highest correlations, —.499 and —.373. For the other items in the Strength Index battery, all but Rogers' arm strength (both swims) and the leg lift (first swim) had correlations with swimming time which reached or nearly reached the .05 level of significance. None of the correlations between swimming time and the items on the Navy Test was significant for either swim.

Strength of the Involved Muscle Groups. The correlation coefficients between times on the first and last swims and the strength of the involved

TABLE 6.—CORRELATIONS BETWEEN TIME FOR THE 200-YARD SWIM AND THE TEST ITEMS OF THE ROGERS STRENGTH TEST, McCLOY'S ARM STRENGTH (PULL-UP), AND THE NAVY STANDARD PHYSICAL FITNESS TEST

Test		First Time Trial	Last Time Trial
Lung capacity	(Rogers)	—.581	—.592
Arm strength	(McCloy)	—.499	—.373
Back lift	(Rogers)	—.433	—.352
Grip strength	(Rogers)	—.353	—.400
Leg lift	(Rogers)	—.289	—.349
Squat thrusts	(Navy)	—.081	—.243
Arm strength	(Rogers)	—.215	—.055
Sit-ups	(Navy)	—.200	—.065
Pull-ups	(Navy)	—.157	.064
Push-ups	(Navy)	.097	.066
Squat jumps	(Navy)	.053	.000

muscles for the pre-experimentation period and the post-experimentation period are presented in Table 7. The correlation coefficient between time on the first swim and the score achieved in shoulder flexion strength was —.610, which is the highest obtained in this study; it was statistically significant well beyond the .01 level of confidence. The correlation coefficients between time on the first swim and shoulder extension strength (—.393) and between time on the last swim and shoulder flexion strength (—.380) were significant at the .05 level of confidence. None of the other correlations was significant for either swim, with coefficients ranging from —.064 to —.304.

Strength Decrement Indexes. None of the correlation coefficients between the times for the first and last time trials and the strength decrements of the involved muscles resulting from the first and last time trials was large enough to be considered statistically significant. The highest coefficients for the first time trial were .264 for hip extension and .233 for hip flexion. The highest coefficients for the last time trial were .319 for the mean strength decrement, which approached the .05 level of confidence, and .277 for hip extension.

Multiple Correlations. Multiple correlations were computed by the Wherry-Doolittle method (6). The correlations were obtained separately for subjects in the unconditioned and conditioned states.

Pre-Experimentation Testing. Utilizing those test items (Tables 6 and 7)

TABLE 7.—CORRELATIONS BETWEEN TIME FOR THE 200-YARD SWIM AND THE STRENGTH OF THE INVOLVED MUSCLES

Test	First Time Trial	Last Time Trial
Shoulder flexors	—.610	—.380
Shoulder extensors	—.393	—.064
Hip flexors	—.191	—.189
Hip extensors	—.231	—.200
Knee flexors	—.146	—.202
Knee extensors	—.304	—.148

TABLE 8.—PRE-EXPERIMENTATION TESTS.

INTERCORRELATION MATRIX OF THOSE VARIABLES FROM THE CABLE-TENSION TESTS AND THE ROGERS BATTERY, INCLUDING MCCLOY'S ARM STRENGTH (PULL-UP), THAT CORRELATED HIGHEST WITH THE FIRST TIME TRIAL OF THE 200-YARD SWIM

	Lung Capacity	McCloy's Arm Strength	Shoulder Flexion
Time	—.581	—.499	—.610
Lung capacity		.552	.582
McCloy's arm strength			.682

that had the highest zero-order correlation with time for the first swim, a multiple correlation was computed. The intercorrelation matrix for these data appears in Table 8. When the three highest zero-order correlations were used in the multiple, the computed *R* reached .665. This represents a raise of .055 correlational points above the highest zero-order correlation. With the addition of other variables, no further increase in the size of the multiple resulted. The multiple correlation obtained was well beyond the .538 required for significance at the .01 level of confidence.

Post-Experimentation Testing. For the last swim, all variables that correlated significantly with the criterion (Tables 6 and 7) were combined in a multiple correlation. This intercorrelation matrix is presented in Table 9. The coefficient of multiple correlation for this matrix did not exceed the highest zero-order correlation between an experimental variable and the criterion, which was —.592 with lung capacity. This coefficient is significant well beyond the .01 level of confidence.

TABLE 9.—POST-EXPERIMENTATION TESTS.

INTERCORRELATIONS OF THE VARIABLES HAVING HIGHEST CORRELATIONS WITH THE TIME OF THE LAST TIME TRIAL OF THE 200-YARD SWIM

	McCloy's Arm Strength	Shoulder Flexor Strength	Leg Lift	Back Lift	Lung Capacity	Grip Strength
Time	—.373	—.380	—.349	—.352	—.592	—.400
McCloy's arm strength		.722	.620	.817	.603	.373
Shoulder flexor strength			.406	.724	.537	.231
Leg lift				.464	.528	.357
Back lift					.659	.286
Lung capacity						.520

Discussion

The physical conditioning of the 30 subjects participating in the five weeks of training and conditioning for middle-distance swimming was pronounced, as indicated by the tests utilized in this study. Not only did the mean swimming time improve, but scores on nearly all test items and batteries increased significantly.

Significant improvement in the strength of the muscle groups that were

primarily involved in the swimming arm stroke was achieved, and in addition significant improvement was obtained for the knee extensor and hip extensor muscles. However, no significant increase in strength of the hip flexors or knee flexors resulted from this study.

In the case of the hip flexor muscles, this result may be explained by the instructional procedures employed, which de-emphasized the downbeat of the kick and emphasized the upbeat of the kick. This procedure was followed since there is a general tendency for nonexpert swimmers to put too much emphasis on the downbeat and not enough on the upbeat of the kick. Thus, less stress was placed on the hip flexors which primarily produced the downbeat of the kick; hence, less strength gain resulted for these muscles.

Although emphasis was placed on the upbeat of the kick, it is understandable that no great stress could be placed on the knee flexors since hyperextension of the lower leg is prevented by the hinge type joint of the knee. Only slight static contraction of the knee flexors is necessary to prevent joint strain from the force of the water. Therefore, this may explain the lack of improvement in strength of the knee flexors.

No significant differences between SDI's resulting from the first and last recorded 200-yard swim time trials were obtained, despite the fact that the effects of conditioning were pronounced. This may be explained by the fact that the subjects swam all-out on both time trials, so that approximately the same amount of fatigue occurred each time. If fatigue is of a certain magnitude, loss in applicable muscular strength is, to some degree, in proportion. Therefore, it may be assumed that, although fatigue of approximately the same degree was incurred at the last time trial as was incurred at the first time trial, muscular endurance was increased by the training and conditioning program as evidenced by the mean decrease of 23.7 seconds required to swim the 200-yard event.

The muscle group that suffered the most strength loss on the first time trial was the shoulder extensors, which had a 22.23 percent mean loss in strength. The shoulder flexors had a 14.33 percent loss in strength. These two muscle groups are primarily involved in the arm stroke. The shoulder extensors, which had the greatest loss in strength, are directly responsible for the propulsive phase of the arm stroke, and the shoulder flexors are indirectly involved in the recovery phase. At the last time trial the shoulder extensors had a 4.00 percent less loss in applicable muscular strength, and the shoulder flexors had a 3.22 percent less loss in strength as compared to the first time trial.

As stated above, the shoulder flexors are indirectly involved with the recovery phase of the arm stroke. It is during this phase only that the arm has the opportunity to relax and rest momentarily. It is a common mistake of swimmers of average skill not to take advantage of this possible brief resting period. Therefore, one of the aims of the training and conditioning program was an attempt to develop a distinct relaxed arm recovery.

For the muscle groups primarily involved in the kicking phase of the crawl

stroke, at the first time trial, the hip flexors experienced the greatest percentage loss in strength (17.63). At the last time trial hip extensors showed the greatest percentage loss in strength (14.86). It is noted that the greatest differences between SDI's for the first and last time trials are shown by the hip flexors with an 8.84 percent less loss in strength, while the hip extensors showed a greater loss in strength by 2.82 percent.

As was previously stated, one of the aims of the instructional procedures was to de-emphasize the downbeat of the kick and to emphasize the upbeat. Some measure of success apparently was achieved since a far greater loss of strength resulted from the upbeat than resulted from the downbeat on the final time trial.

It was found that no zero-order or multiple coefficient of correlation was obtained that was sufficiently high to be of value for prediction of swimming time when the subjects were in either the unconditioned or conditioned states. However, a number of fairly high correlations were obtained. Lung capacity correlated highest with 200-yard swimming time when the subjects were in the conditioned state and next to highest when in the unconditioned state (—.592 and —.581 respectively). To some extent these consistently high correlations might partially be explained through research reported by Cureton (3) in which he found that a 6.12 percent loss in lung capacity occurred when the subject was immersed in water to chin level. He attributed this loss to water pressure and assumed that respiratory fatigue would come about more quickly due to this extra pressure. If this assumption is correct, it is understandable that the person with the largest lung capacity may be able to prolong respiratory fatigue longer than could one with less lung capacity and would then be capable of performing better in an endurance event.

Other relatively high correlations with both first and last swimming times were the following: shoulder flexion strength, McCloy's arm strength, grip strength, back lift, Rogers' Strength Index, and leg lift. All of these measures but one are of gross muscular strength, with test scores recorded on instruments. The exception is McCloy's arm strength score, which is a muscular endurance test, derived from chins and dips and related to body weight by formula. While the Strength Index is predominantly instrument testing, arm strength is also included based on chins and dips.

That these muscular strength measurements are factors related to the time required to swim the 200-yard event might be explained in part by other research reported by this writer (4) in which it was found that participation in an intensive and comprehensive weight-training program significantly decreased the time required to swim the 25- and 50-yard crawl stroke events.

Conclusions

The results obtained in this study indicate the following conclusions:

1. General physical fitness, motor fitness, gross strength, and swimming time all evidenced highly significant improvement.

2. All test items of the various test batteries, with the exception of grip strength, showed improvement well beyond the .01 level of confidence.

3. Significant improvement was obtained in the cable-tension strength of the knee extensors, shoulder flexors, and shoulder extensors.

4. The highest significant relationships obtained between swimming time and all variables studied were lung capacity and various gross strength measures.

5. No significant differences were found for cardiovascular condition or the strength decrement indexes.

References

1. Clarke, H. Harrison, and Peterson, K. J. *Strength Tests of Affected Muscle Groups Involved in Orthopedic Disabilities.* Unpublished manuscript. Eugene: University of Oregon.
2. Clarke, H. Harrison; Shay, C. T.; and Mathews, D. K. "Strength Decrement Index: A New Test of Muscle Fatigue." *Archives of Physical Medicine and Rehabilitation* 36:376–78; 1955.
3. Cureton, T. K., Jr. "Relationship of Respiration to Speed Efficiency in Swimming." *Research Quarterly* 1:57–59; March 1930.
4. Davis, Jack F. "The Effect of Weight Training on Speed in Swimming." *The Physical Educator* 12:28–29; 1955.
5. Dixon, W. J., and Massey, F. J. Jr. *Introduction to Statistical Analysis.* New York: McGraw-Hill Book Company, Inc., 1951.
6. Garrett, H. E. *Statistics in Psychology and Education.* New York: Longmans, Green and Co., 1951.
7. Harvey, N. J. *A Study of the Changes in Muscular Strengths, Size, and Endurance Which Occurred in a Swimming Situation.* Master's thesis. Eugene: University of Oregon, 1943.
8. Kistler, Joy W. "A Study of the Results of Eight Weeks of Participation in a University Fitness Program for Men." *Research Quarterly* 15:23–28; March 1944.
9. Landiss, C. W. *Relative Influence of Various Physical Education Activities on Motor Ability and Physical Fitness on Male College Freshmen.* Doctoral dissertation. State College, Pa.: Pennsylvania State College, 1951. (*Health and Physical Education Microcards,* University of Oregon.)
10. McCloy, C. H. *Tests and Measurements in Health and Physical Education.* New York: Appleton-Century-Crofts, Inc., 1942.
11. *Physical Fitness Manual for the U. S. Navy,* Chapter IV. Washington, D. C.: Bureau of Naval Personnel, Training Division, Physical Section, 1943.
12. Rogers, F. R. *Physical Capacity Tests in the Administration of Physical Education.* New York: Bureau of Publications, Teachers College, Columbia University, 1925.
13. Schneider, E. C. "A Cardiovascular Rating as a Measure of Physical Fatigue and Efficiency." *Journal of the American Medical Association* 74:1507–10; 1920.
14. Wilbur, E. A. "A Comparative Study of Physical Fitness Indices as Measured by Two Programs of Physical Education: the Sports Method and the Apparatus Method." *Research Quarterly* 14:326–32; October 1943.

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A Cinematographical Analysis of the Dolphin Swimming Stroke[1]

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Abstract

The dolphin butterfly stroke is relatively new in intercollegiate swimming competition, and it is apparent that many different methods of timing the kick with the arm stroke are being used. This study presents a method for the measurement of component velocities within one swimming stroke cycle. The ratio of maximum to minimum component velocities is suggested as an index of stroke efficiency. The method presented was used to analyze and compare these variations in velocity within the stroke cycle of two outstanding dolphin butterfly stroke swimmers. An attempt was made to identify factors of body mechanics which might have contributed to the variance of velocities within the stroke cycle of these swimmers. Since acceleration and deceleration are costly in terms of energy requirements, it is thought that the method presented may provide an approach to improving swimming.

HISTORY HAS SHOWN a gradual evolutionary process in the development of racing swimming strokes such as the American crawl stroke and the back crawl stroke. It is reasonable to assume that the dolphin butterfly stroke is at present undergoing a similar process of evolution since it has so recently been accepted in the intercollegiate and interscholastic program of events. Evidence in this direction is furnished by the differences of timing and body mechanics observed in some oustanding dolphin swimmers.

That acceleration and its consequent deceleration are more costly in terms of energy output than a steady rate in human movement has been an accepted fact of kinesiology. Karpovich demonstrated its application to the area of swimming in 1935 (9).

With the above principle in mind, it was felt that a measure of acceleration and deceleration within a swimmer's stroke cycle might very well offer the swimming coach a usable criterion of stroke efficiency. Quantifying acceleration and deceleration were accomplished by underwater photography through an underwater observation window. The swimmer was photographed in reference to a grid screen and a 0.01 sec. electric timer, at 128 frames per second. The film was analyzed by computing the distance moved by the swimmer each 0.1 second through the stroke cycle, from which data component velocities within the stroke cycle were computed. The highest velocity achieved was

[1]This study was made in partial fulfillment of requirements for the degree of Doctor of Philosophy at the University of Southern California, 1958, under the direction of Dr. John Cooper.

compared with the lowest velocity in the form of a ratio to give an index of the degree of acceleration and deceleration within the stroke cycles of two outstanding dolphin swimmers. These ratios were also compared with the ratio found in an outstanding crawl swimmer. The arm, trunk, and leg positions were also recorded for each 0.1 sec. interval, and an analysis was postulated in explanation of the observed variations.

Review of the Literature

According to Armbruster (3), the dolphin fishtail butterfly stroke was developed at the University of Iowa in 1935 by David A. Armbruster and Jack Sieg. However, it was not accepted officially in intercollegiate competition until 1955.

Many excellent analyses of swimming strokes have been made in terms of mechanics and kinesiology by Cureton (8), Armbruster (3), Rajki (11), and Wetmore (13). Water resistance has been investigated by Karpovich (9, 11) and Alley (1). Counsilman (7) has made very meaningful contributions in respect to the forces involved in the glide and continuous type of arm actions in the American crawl stroke. He has also analyzed the old butterfly stroke with the whip kick (6). Karpovich (10), Karpovich and Alteveer (12), and Plummer (13) have investigated cyclic velocity variations with the Natograph. However, Plummer (13) states:

> The Natograph, the testing instrument, is not a practical piece of apparatus for testing swimmers as it requires much detailed work before conclusions can be drawn. However, if it can be improved so that it will record speed variations directly on paper it may be used as a practical instrument for testing swimmers; otherwise it is valuable only for research.

Methods and Procedures

Two subjects were used in the study. Subject A was a national interscholastic record holder in the dolphin butterfly stroke whose best time up to the time of this study was 55.5 seconds for the 100-yd. dolphin butterfly event. Subject B was one of the better intercollegiate butterfly swimmers of the area whose best time for the 100-yd. dolphin butterfly event was 60.0 sec.

A grid screen was constructed of three vertical yardsticks from which was suspended a 1/4 x 2 in. iron bar 6 ft. long which served to keep the yardsticks plumb and against the far wall of the swimming pool. These three yardsticks were suspended vertically, parallel, and on 36-in. centers under water on the opposite wall 35 ft. across the pool from an underwater observation window. Every other inch of the yardsticks was taped with black plastic adhesive tape, as was every other inch of the horizontal iron bar, thus providing a 3 x 6 ft. grid screen. This taping served to provide reference points against which to measure the forward progress of the swimmers.

Underwater motion pictures were taken with a Bell and Howell "Hi Speed" 16mm movie camera at 128 frames per second through the underwater observation window. It was found that it was necessary to use a high speed film of the "Cine Kodak Tri-X" type with an ASA number of 200.

Each swimmer was allowed to warm up in his own accustomed manner until he felt ready to make an all-out effort. He was then instructed to swim one length, using a butterfly stroke, as fast as he could, in the lane closest to the wall on which the underwater grid screen was mounted. Each swimmer's perpendicular distance from the grid screen as he swam by it was approximately 5 ft. He was photographed from the time any part of his body crossed the first vertical yardstick until every part of his body had passed beyond the third vertical yardstick. The distance horizontally from the center of the first yardstick to the center of the third yardstick was exactly 6 ft.

Each swimmer was also timed by stop watch from the time he made his first movement of the starting windup to the touch in at the other end of the pool.

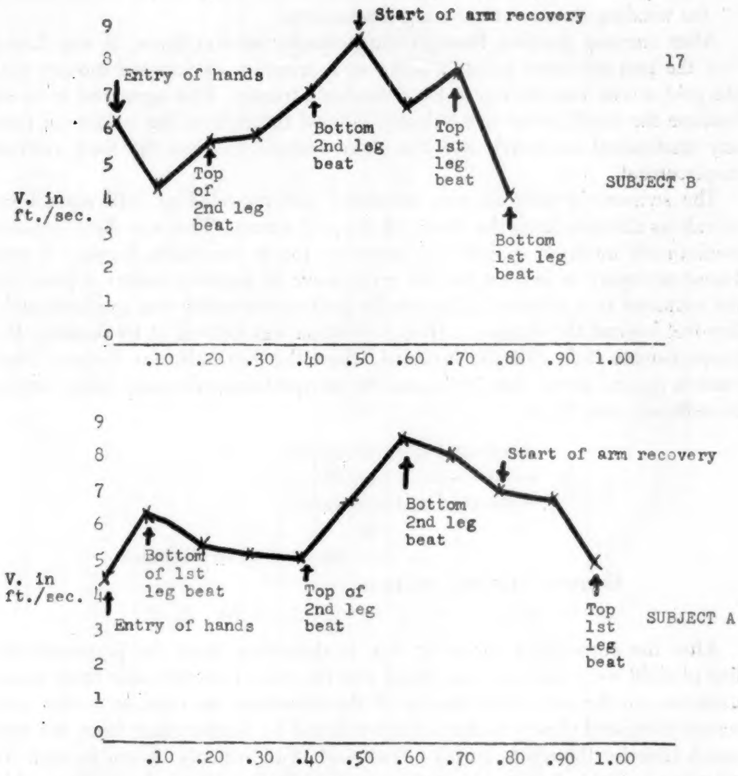

FIGURE I. Comparison of velocities within the dolphin stroke cycle with both subjects starting at the entry of the hands.

In order to eliminate errors in timing the swimmer underwater with the movie camera, which was spring wound, a three-second sequence of a 1/100 sec. electric timer was photographed from the fully wound position of the camera immediately prior to photographing the swimmers, and every sequence of the swimmers also was started with the camera fully wound.

In analyzing the films, the sequence of the electric timer was run parallel to the sequence of the swimmer. Both of these 16mm films were run simultaneously through a 35mm slide projector which was specially prepared to do this job. The starting frame of the timer and the starting frame of the sequence of the swimmer were aligned, and this alignment was maintained throughout the analysis of that particular sequence so that an accurate time could be recorded at any point within the stroke cycle. This was done in preference to counting frames as a method of timing because the camera used was spring wound and it was felt that considerable error would be introduced by the winding down of the spring mechanism.

After running the film through the projector several times, it was found that the best reference point to serve as a criterion of forward motion past the grid screen was the top of the swimmer's trunks. This appeared to be so because the trunks were more clearly defined throughout the sequences than any anatomical landmark and this point seemed to have the least vertical displacement.

The swimmer's progress was measured and recorded at 0.10 second intervals as distance from the center of the grid screen. This was done because preliminary analyses showed the necessity for a correction factor. It was found necessary to correct for the error made in sighting across a point on the swimmer to a reference point on the grid screen which was approximately five feet beyond the swimmer. This correction was arrived at by drawing the proportionate right triangles involved, where the perpendicular distance from camera to grid screen was 35 ft. and the perpendicular distance from camera to swimmer was 30 ft.

$$\frac{\text{Corrected distance swum}}{\text{Observed distance swum}} = \frac{30}{35}$$

or

$$\text{Corrected distance swum} = \frac{30 \times \text{observed distance}}{35}$$

After the corrections for error due to deflection from the perpendicular line of sight were made, it was found that the velocities computed from measurements on the projected images of the swimmers in relation to the grid screen compared closely to the velocities found by computation from the stop watch time for the whole length of the pool. For example, it can be seen by referring to Table 1 that subject A swam 6.67 ft. in 1.10 sec. by photographic measurements. This is 6.07 ft. per second. This same performance was timed

TABLE 1.—ANALYSIS OF VELOCITIES WITHIN THE STROKE CYCLE (DOLPHIN)
SUBJECT A. TIME BY STOPWATCH: 12.0 SEC. FOR 25 YDS.

Timer Reading for Frame in Sec.	Distance (mm.) Trunks from Grid Center	Distance (mm.) Corrected	Distance (mm.) Moved in .10 Sec.	Distance Ft.	Velocity Ft./Sec.	Position of Arms Measured from Horiz.	Position of Legs
0.42	−58	−49.7	—	—	—	120°	Trunk flexed 028°
0.52	−40	−34.3	15.4	.800	8.00	Recovery	Trunk flexed 003°
0.62	−25	−21.4	12.9	.672	6.72	Recovery	Trunk extended 010°
0.72	−10	− 8.6	12.8	.663	6.63	Recovery	Trunk extended 018°
0.82	+01	+ .86	9.5	.492	4.92	Recovery	Trunk extended 025°
0.92	+11	+ 9.4	8.5	.442	4.42	Entry 000°	Trunk flexed 020°
1.02	+25	+21.4	12.0	.622	6.22	010°	Trunk flexed 025°
1.12	+37	+31.7	10.3	.533	5.33	010°	Trunk flexed 018°
1.22	+48	+41.2	9.5	.492	4.92	030°	Trunk flexed 012°
1.32	+59	+50.5	9.3	.484	4.84	065°	Trunk straight 000° Knees flexed 025°
1.42	+73	+62.5	12.0	.622	6.22	090°	Trunk flexed 008°
1.52	+92	+78.9	16.4	.852	8.52	120°	Trunk flexed 030°

Grid screen projected measures 58.0 mm. = 3.0
Time for 1 Stroke Cycle = 1.10 sec.
Distance for 1 Stroke Cycle = 6.67 ft.
Rate for 1 Stroke Cycle = 6.07 ft./sec.
Rate for entire distance = 6.25 ft./sec.

TABLE 2.—ANALYSIS OF VELOCITIES WITHIN THE STROKE CYCLE (DOLPHIN)
SUBJECT B. TIME BY STOPWATCH: 12.9 SEC. FOR 25 YDS.

Timer Reading for Frame in Sec.	Distance (mm.) Trunks from Grid Center		Distance (mm.) Corrected	Distance (mm.) Moved in .10 Sec.	Distance Ft.	Velocity Ft./Sec.	Position of Arms Measured from Horiz.	Position of Legs
0.65	−55		−47.2	——	——	——	000° entry	Trunk flexed 035°
0.75	−46		−39.4	7.8	.427	4.27	−005°	Trunk flexed 022°
0.85	−34	Grid 55 mm. = 3.0 ft.	−29.2	10.2	.557	5.57	027°	Trunk flexed 000°
0.95	−22		−18.8	10.4	.567	5.67	050°	Trunk just starting flexion
1.05	−08		− 6.8	12.0	.685	6.85	085°	Full trunk flexion 035°
1.15	+11		+ 9.4	16.2	.824	8.24	Swirls obscure 170° (?)	Legs starting up 023°
1.25	+25		+21.4	12.0	.611	6.11	Recovery	Trunk flexion 013°
1.35	+42	Grid 59 mm. = 3.0 ft.	+36.0	14.6	.744	7.44	Recovery	Trunk extension 010°
1.45	+51		+43.7	7.7	.394	3.94	Recovery	Trunk flexion 022°
1.55	+65		+55.8	21.1	.615	6.15	000° Entry	Trunk flexion 032°

NOTE: From 090° point in Arm cycle onward cavitations are severe.
Time for 1 stroke cycle = .90 sec.
Distance for 1 stroke cycle = 5.43 ft.
Rate for 1 stroke cycle = 6.03 ft./sec.
Rate for entire distance = 5.82 ft./sec.

TABLE 3.—ANALYSIS OF VELOCITIES WITHIN THE STROKE CYCLE (CRAWL)
SUBJECT A. TIME BY STOPWATCH: 11.0 SEC. FOR 25 YDS.

Timer Reading for Frame in Sec.	Distance (mm.) Trunks from Grid Center	Distance (mm.) Corrected	Distance (mm.) Moved in .10 Sec.	Distance Ft.	Velocity Ft./Sec.	Positionof Arms Measured from Horiz.	Position of Legs
0.64	−58	−49.7	......	......	......	L. arm 030°	R. leg top of beat
0.74	−42	−36.0	13.7	.710	7.10	L. arm 055°	R. leg full down
0.84	−28	−24.0	12.0	.625	6.25	L. arm 085°	L. leg coming down
0.94	−11	− 9.4	14.6	.755	7.55	L. arm 110°	L. leg full down
1.04	cannot measure	......	......	......	......	L. arm 150°	R. leg coming down
1.14	+18	+15.4	24.8/.20 sec.	.643	6.43	R. arm entry L. arm release	L. leg coming down
1.24	+32	+27.4	12.0	.625	6.25	R. arm 027° L. arm recovery	L. leg coming down
1.34	+44	+37.8	10.4	.539	5.39	R. arm 065° L. arm recovery	L. leg full down
1.44	+60	+51.5	13.7	.710	7.10	R. arm 095° L. arm recovery	R. leg coming down
1.54	+77	+66.0	14.5	.750	7.50	R. arm 133° L. arm recovery	L. leg coming down
1.64	+95	+81.5	15.5	.803	8.03	Cannot see arms	R. leg top of beat

Grid Screen projected measures 58.0 mm. = 3.0 ft.
Time for 1 stroke cycle = 1.00 sec.
Distance for 1 stroke cycle = 6.78 ft.
Rate for 1 stroke cycle = 6.78 ft./sec.
Rate for entire distance = 6.82 ft./sec.

for the whole length of the pool in 12.0 sec. for 75 ft. or a velocity of 6.25 ft. per second. Thus it can be seen that the error of photographic measurement of velocity as compared to velocity measurement by stop watch for a 75-ft. distance is probably less than 3 percent, since the 6.25 ft. per second velocity includes within it a racing start.

Analysis of the Data

Consulting Table 4, it can be seen that subject A swam slightly faster but took fewer strokes per unit time than did subject B. Subject A took one stroke per 1.10 sec. while subject B took one stroke per .90 sec., although subject A swam at a velocity of 6.07 ft./sec. compared with a velocity of 6.03 ft./sec. for B. Subject A covered 6.67 ft. in one stroke while B covered only 5.43 ft. in one stroke.

The variance in velocities within the stroke cycles was greater for B, whose highest velocity was 8.24 ft./sec. and lowest was 3.94 ft./sec. Subject A varied slightly less, with a high velocity of 8.52 ft. per second and a low velocity of 4.42. Putting these figures into ratios for easier comparison, subject A's ratio (highest velocity over lowest velocity) was 1.94 while B's was 2.10.

The highest velocity occurred for both swimmers toward the completion of the arm stroke. The lowest velocity occurred for both swimmers in the last part of the arm recovery.

Figure 1 and comparisons of Tables 1 and 2 seem to show that for swimmer A there is an increase in velocity following entry of the hands, while for subject B there is a decrease in velocity following the entry of the hands.

It can also be observed that subject A finishes the downbeat of the first kick which started during the recovery phase of the arms approximately 0.10 sec. after the entry of the hands, whereas subject B finishes the downbeat of the first kick at approximately the time of the entry of the hands into the water. However, subject A also gets considerably more trunk extension, 025 deg. preceding the first kick, than does subject B, whose trunk extension measured only 010 deg.

TABLE 4.—A COMPARISON OF SUBJECT A VS. SUBJECT B

Comparison	Subject A Dolphin	Subject B Dolphin	Subject A Crawl
Distance Per Stroke Cycle	6.67 ft.	5.43 ft.	6.78 ft.
Time Per Stroke Cycle	1.10 sec.	.90 sec.	1.00 sec.
Mean Vel. Per Stroke Cycle	6.07 ft./sec.	6.03 ft./sec.	6.78 ft./sec.
Highest Vel. within Stroke	Arms 090°-120° 8.52 ft./sec.	Arms 085°-170° 8.24 ft./sec.	8.03 ft./sec.
Lowest Vel. within Stroke	Arms in last part of recovery 4.42 ft./sec.	Arms in last part of recovery 3.94 ft./sec.	5.39 ft./sec.
Ratio $\frac{\text{Highest V}}{\text{Lowest V}}$	1.94	2.10	1.54

A rather important point noticed during the analysis of the films was that subject A's arm stroke was almost free of any cavitations while the arm stroke of subject B was very difficult to analyze from the 090 deg. point onward because of severe cavitations.

Referring again to Table 4, if the acceleration-deceleration ratio for the crawl is compared with that for the dolphin—both were computed for subject A in all-out performances—ratios of 1.54 for the crawl and 1.94 for the dolphin are found. This shows very clearly what might be expected, namely, that there is not nearly so much starting and stopping, as it were, in the crawl stroke because of the more constant application of power, by virtue of the alternating arm stroke.

Table 5 provides a comparison of the stroke timing as taken from Armbruster (3:174) with that of the two subjects in the present study. It can readily be seen that differences exist in timing the kick with the arms in the dolphin stroke. Whereas in Armbruster's illustration the swimmer starts his first downward kick at approximately the entry of the hands, both of the subjects in this study started their first downward kick during recovery (considerably earlier). Armbruster's illustration has the swimmer starting the second kick when his arms have progressed approximately 030 deg. from the entry of the hands, while both subjects in this study started the second downward kick after their arms had completed approximately 080 deg. of their downward arc. The point of greatest divergence seems to be the phase of the kick at which the hands make their entry. In Armbruster's illustration, it appears that the first downward movement of the legs has just begun at the entry of the hands while subject A is approximately halfway through his first downward leg beat and subject B is completing his first downward kick at the same point.

It is possible that the difference seen in Figure I between subject A's increasing velocity at the entry of the hands and subject B's decreasing velocity at the entry is due to the fact that A still has some kick driving him at the entry point while B does not.

TABLE 5.—COMPARISON OF STROKE TIMING, SUBJECTS A AND B, WITH ARMBRUSTER SERIES OF IDEAL FORM (3:174-5)

Subject	Arm Position at Start of First Kick (Angle, etc.)	Arm Position at Start of Second Kick (Angle with Surface)	Phase of Kick at Entry of Hands
Armbruster	Entry	030° beyond entry	Just past starting point of first kick
Subject A	Recovery (exact position cannot be determined)	080/ beyond entry	Approx. halfway through downbeat of first kick
Subject B	Recovery (exact position cannot be determined)	080/ beyond entry	Completion of downbeat of first kick

It would be presumptuous to attempt to draw any far-reaching conclusions from an analysis such as this, for many reasons, some of which follow:

(a) only two stroke cycles were analyzed for each swimmer, and these could very well be atypical, (b) it would be desirable to use many more subjects of top flight calibre if they were available, and (c) several variables acted simultaneously and no controls were available.

Specifically, it would be impossible to attribute the difference in variance immediately following the entry of the hands in the case of these two subjects to one variable because they varied not only in timing but also in the degree of trunk extension preceding the kick and in the depth of flexion in the kick.

This study does, however, present an analysis of the performance of two outstanding performers in this new stroke and presents a method by which analyses of other swimmers may be made. Since acceleration and deceleration are costly in terms of energy requirements, it is thought that the present method may provide an approach to improving swimming methodology.

References

1. Alley, Louis E. "An Analysis of Water Resistance and Propulsion in Swimming the Crawl Stroke." *Research Quarterly* 23:253-70; October 1952.
2. American Association for Health, Physical Education, and Recreation. *Research Methods Applied to Health, Physical Education and Recreation.* Washington, D. C.: American Association for Health, Physical Education, and Recreation, 1952.
3. Armbruster, David A. *Competitive Swimming and Diving.* St. Louis: C. V. Mosby Company, 1942.
4. Black, Newton Henry. *An Introductory Course in College Physics.* New York: Macmillan Company, 1935.
5. Bunn, John W. *Scientific Principles of Coaching.* New York: Prentice Hall, Inc., 1955.
6. Counsilman, James. "The Butterfly Breaststroke." *Athletic Journal* 33:26-27; February 1953.
7. Counsilman, James. "Forces in Swimming Two Types of Crawl Stroke." *Research Quarterly* 26:127; May 1955.
8. Cureton, Thomas K. "Mechanics and Kinesiology of Swimming." *Research Quarterly* 1:87; December 1930.
9. Karpovich, Peter V. "An Analysis of the Propelling Force in the Crawl Stroke." *Research Quarterly* 6: 49-58; May 1935 supplement.
10. Karpovich, Peter V. "Swimming Speed Analyzed." *Scientific American;* March 1930.
11. Karpovich, Peter V. "Water Resistance in Swimming." *Research Quarterly* 4:21; October 1933.
12. Karpovich, Peter V., and Alteveer, Robert J. "Natographic Analysis of the Butterfly Stroke." Springfield, Mass.: Springfield College, Department of Physiology.
13. Plummer, Clayton R. "Cyclic Velocity Variations of the Breast and Butterfly Strokes." Master's thesis. Springfield, Mass.: Springfield College, 1940.
14. Rajki, Bela. *The Technique of Competitive Swimming.* Budapest: University Printing House, 1956.
15. Rebikoff, Dimitri, and Cherney, Paul. *A Guide to Underwater Photography.* New York: Greenburg, 1955.
16. Wetmore, Reagh C. "Experimental Data Applied to Crawl and Breaststrokes." *Athletic Journal* 33:30; November 1952.

(Submitted 2/25/59)

Coeducational Physical Education in Institutions of Higher Learning[1]

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Abstract

The purpose of this study was to secure information about the extent of coeducation in college physical education programs and about the practices which govern these programs. Data were gathered by means of a 174-item questionnaire returned from 269 physical educators representing 48 states. It was concluded that (a) coeducational physical education programs are well established in the United States, (b) coeducational physical education programs are better established in public institutions than in private institutions and are better established in the Southwest, (c) prevalent practices are in accord with the consensus on expressed opinions, and (d) certain cultural and historical patterns have influenced coeducational physical education programs at various periods.

COEDUCATION has been well established in higher education for many years, but it is only within the past 25 years that the educational possibilities of joint participation by men and women in the sports and recreational activities of the physical education program have been recognized. No comprehensive study of the development of coeducation in college programs of physical education has been made in recent years, but there is evidence that coeducational classes have now become a well-established part of many college physical education programs.

Purpose of the Study

The purpose of this study was to secure information and opinions from a representative group of physical educators about coeducation in college physical education programs. Agreement and disagreement among these physical educators concerning objectives, principles, practices, and trends in coeducational physical education were studied in relation to such relevant factors as type of institution, age, and geographical area. The extent to which current practices reflect consensus of stated ideas about coeducational physical education was studied. Certain cultural and historical patterns which may or may not have affected the development of coeducational physical education programs were examined, and trends in coeducational physical education since 1920 were discussed.

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[1] Abstract of a study conducted at the University of Southern California in partial fulfillment of the requirement for the Degree of Doctor of Education, 1957.

Construction of the Questionnaire

The only feasible way to secure the desired data about coeducational physical education at the college level from respondents in all areas of the United States was by questionnaire. Accordingly, standard writings on questionnaire construction and other literature concerning measurement of opinions were consulted. The literature on coeducational physical education, with emphasis on the programs in colleges and universities, was carefully studied. Approximately 180 preliminary statements concerning objectives, principles, practices, trends, and factors favorable and unfavorable to coeducational physical education were derived or formulated from this study of professional books, periodicals, and recent research literature. The tentative final draft of the questionnaire developed from these statements was submitted to a jury of physical educators at the University of Southern California.

The final revision of the questionnaire contained 174 items, classified as follows:

Part I solicited data concerning basic policies of the physical education program and information about existing coeducational physical education classes. These responses were analyzed according to percentage of respondents.

Part II contained statements of opinion regarding general objectives, principles, factors favorable and unfavorable to the development of coeducational programs, and activities suitable for coeducational classes. Responses to items concerning opinions about coeducational physical education were interpreted by means of an index score which noted the degree of agreement or disagreement with a statement. Statements pertaining to opinion were analyzed according to unanimity of opinion or variance of opinion among the respondent groups.

Distribution of the Questionnaire

A mimeographed double post card was sent to 157 men who were members of the College Physical Education Association and 364 women who were members of the National Association of Physical Education for College Women to determine their willingness to complete the questionnaire. Only those members were surveyed who represented four-year institutions. Of the total group of 521, 366 (73%) agreed to supply information.

The 12-page booklet questionnaire was mailed to 366 individual recipients; 133 members of the College Physical Education Association representing 45 states and 233 members of the National Association of Physical Education for College Women, representing institutions in 48 states. Returns are indicated in Table 1.

Trends in Coeducational Physical Education

Prior to 1929, few coeducational classes had been established. Less than 7 percent of the respondents indicated that such classes had existed in their

TABLE 1.—ANALYSES OF QUESTIONNAIRE DISTRIBUTION AND RETURN

Groups Receiving Questionnaire	Number Sent	Number Returned	Percent Returned
Total Number	**366**	**269**	**73**
College Physical Education Association	133	100	75
National Association of Physical Education for College Women	233	169	73
Public Institutions	181	142	78
Private Institutions	185	127	68
Northwest District	15	14	93
Southwest District	39	32	82
Central District	58	46	79
Midwest District	85	59	69
Southern District	77	63	82
Eastern District	92	55	60

institutions, but it is interesting to note that some classes had been established in all geographical areas except the Northwest (see Table 2).

During the depression years (1929-35), some increase in the number of coeducational classes was evident in the Northwestern, Southwestern, and Midwestern districts.[2]

TABLE 2.—PREVALENCE OF COEDUCATIONAL PHYSICAL EDUCATION ACCORDING TO DISTRICTS FROM 1920 TO 1956

District Respondents		1920-1929 Yes %	1920-1929 No %	1929-1935 Yes %	1929-1935 No %	1936-1941 Yes %	1936-1941 No %	1941-1945 Yes %	1941-1945 No %	1945-1950 Yes %	1945-1950 No %	1950-1956 Yes %	1950-1956 No %
Northwest	M	0	100	17	83	17	83	0	100	67	33	83	17
	W	0	100	13	88	50	50	50	50	75	25	75	25
Southwest	M	10	90	30	70	40	60	40	60	70	30	100	0
	W	9	91	18	82	45	55	68	32	91	9	91	9
Central	M	8	92	8	92	23	77	15	85	69	31	77	23
	W	12	82	18	82	36	64	48	52	82	18	97	3
Midwest	M	5	95	14	86	36	64	36	64	73	27	73	27
	W	11	89	22	78	29	71	24	76	51	49	78	22
Southern	M	15	85	15	85	42	58	50	50	69	21	81	19
	W	3	97	5	95	14	86	16	84	49	51	76	24
Eastern	M	4	96	8	92	13	87	8	92	33	67	75	25
	W	10	90	10	90	10	90	9	91	18	82	45	55

[2] Districts used follow those now designated by the AAHPER.

With reference to the years prior to World War II (1936-41), 30 percent of the men and 32 percent of the women in public institutions reported that coeducational classes were conducted in their departments. In the private institutions, 26 percent of the men and 20 percent of the women reported that coeducational classes had been established. This increase in the number of coeducational programs was particularly evident in the Southwestern, Central, Midwestern, and Southern districts.

During World War II, coeducational physical education programs were curtailed in both public and private institutions. This reduction was particularly evident in the Northwestern, Central, Midwestern, and Eastern districts of the United States.

TABLE 3.—PREVALENCE OF COEDUCATIONAL PHYSICAL EDUCATION IN PUBLIC AND PRIVATE INSTITUTIONS FROM 1920-1956

Respondents	1920-1929		1929-1935		1936-1941		1941-1945		1945-1950		1950-1956	
	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %	Yes %	No %
Public												
Men Respondents	6	94	9	91	30	70	30	70	65	35	82	18
Women Respondents	12	88	23	89	32	68	45	55	80	20	6	7
Total	10	90	17	83	31	68	39	61	74	26	88	12
Private												
Men Respondents	7	93	16	84	26	75	21	79	58	42	72	78
Women Respondents	6	94	4	96	20	80	27	73	39	61	60	40
Total	6	94	8	92	22	78	25	75	45	55	64	36

During the postwar years (1945-50), the number of coeducational classes increased rapidly. In public institutions, 65 percent of the men and 80 percent of the women, and, in private institutions, 58 percent of the men and 39 percent of the women, noted that coeducational classes were taught.

During the years 1951–56, the number of coeducational physical education programs has continued to increase. In private institutions, 82 percent of the men and 93 percent of the women, and, in private institutions, 72 percent of the men and 60 percent of the women, stated that coeducational classes were being conducted in their schools. Such classes were most prevalent in the Southwestern, with the Central, Northwestern, Southern, and Midwestern districts following in that order.

Coeducational physical education programs are more prevalent in public institutions than in private institutions and are less commonly found in the Eastern district than in other parts of the United States.

Future Predictions

In the next decade, according to all respondents, the trend will be toward placing a greater emphasis on improved mental and emotional health, individual and dual sports, and improved human relations and social skills. Those who now offer coeducational programs believe that there will be an expansion of coeducational programs in the next decade.

Although the women respondents who do not offer coeducational programs were indecisive, all other responding groups did not believe that many schools will discontinue the coeducational programs that now exist.

Since World War II, despite increased enrollments or perhaps because of them, coeducational programs have expanded. There was unanimous, complete agreement by all responding groups that the following were factors favorable to the development of coeducational physical education on the college and university level: (a) the increased emphasis in education on the preparation for the worthy use of leisure, (b) the increased emphasis in physical education upon social development, (c) the students' interest in associating with one another in informal social activities, (d) the increased emphasis in the general college curriculum upon the teaching of skills utilized in adult living, and (e) the re-education of the public regarding the values of a coeducational program.

Women more than men, and the coeducational group more than the non-coeducational groups, believed that the increasing participation of women in social, economic, and political areas of our culture was a favorable factor in the development of coeducational programs.

The forecast for coeducational physical education appears promising. With the introduction of automation and the predicted shortening of working hours, the need for continuing emphasis on the preparation for worthy use of leisure should become increasingly more important in education. Predicted increases in college enrollments and accompanying insufficient monies for education may enhance the development of coeducational programs. Since previous world wars seemingly have not decreased the number of the programs, it may be presumed that expansion of coeducational physical education may be temporarily curtailed in the event of another world war. Thus, it may be assumed the trend toward increased offerings in coeducational physical education will continue.

Findings

1. Ninety-five percent of the total respondents indicated that physical education was required for graduation, including 134, or 95 percent, of the public institution respondents and 111, or 87 percent, of the private institution respondents.

2. Of the total respondent group, 75 percent indicated that academic credit was given for physical education, including 188, or 83 percent, of public institutions and 84, or 66 percent, of private institutions.

3. Of the public institution respondents, 125, or 88 percent, indicated they had coeducational programs. Of the private institution respondents, 82, or 64 percent, indicated they had coeducational physical education programs.

4. Coeducational physical education programs were far more prevalent in the Southwest and least prevalent in the Eastern states.

5. Of the 42 activities listed in the questionnaire,[3] only two were listed as specific requirements for all students. Swimming was listed in 26 percent of the colleges and body mechanics in 16 percent. Thirty-eight, or 90 percent, of the activities were listed as part of a department requirement which could be met by selecting courses from an approved list. In addition, 25, or 59 percent, of the activities were listed as courses which might be elected in addition to a specific requirement. The activities considered most suitable for coeducational classes were dance activities, aquatics, and individual and dual sports (archery, badminton, tennis, golf). Volleyball was the only team sport approved for coeducational classes.

6. Of the total activities listed, 30, or 71 percent, were offered as coeducational classes, but only 18 were offered as coeducational classes by more than 10 percent of the respondents. These activities were social, folk, square, and modern dance, archery, lifesaving, swimming, golf, badminton, tennis, bowling, camping, fencing, skiing, horseback riding, table tennis, volleyball, and shuffleboard.

7. The activities most frequently offered on a coeducational basis in some phase of the intramural or recreational programs were social, folk, modern, and square dance, badminton, swimming, volleyball, bowling, golf, skiing, softball, and shuffleboard.

8. Few institutions reported joint teaching of coeducational classes by men and women instructors. The most frequent practice was to assign either a man or a woman to teach coeducational physical education classes, the assignment being based on qualifications for teaching the specific activity.

9. Those respondents who offered coeducational classes agreed more strongly with the statements about objectives and principles of coeducational physical education than did those who offered separate programs of physical education for men and women.

10. The Eastern, Central, and Midwestern districts were more conservative, while the South, Southwest, and Northwest expressed a greater divergence from traditional points of view about practices in physical education. Older men were more conservative in their opinions. The younger men and women were essentially unanimous in their opinions about practices in coeducational physical education.

11. Marked differences of opinion did not occur between the men and women respondents. Men and women concurred that coeducational physical

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[3] The list of activities was compiled following extensive review of the literature and was an attempt to ascertain which activities were offered on a coeducational basis.

education programs will continue to expand in the future. This opinion was slightly more pronounced among the younger age groups than the older.

12. Increased emphasis in education on the preparation for the worthy use of leisure and increased emphasis in the general college curriculum on the teaching of skills utilized in adult living were factors identified as favorable to the development of coeducational physical education.

13. There was consensus among the respondents that coeducational programs will continue to expand in the future, with the reservation that such expansion might be curtailed in the event of another world war.

Conclusions

On the basis of the findings, the following conclusions appear to be justified:

1. Coeducational physical education programs are well established in the United States. It seems probable that they will not be materially affected by limited budgets or increasing college enrollments but might be curtailed in the event of another world war.

2. Coeducational physical education programs are better established in public institutions than in private institutions and are better established in the Southwest than in any other geographical area.

3. Prevalent practices are in accord with the consensus regarding expressed ideas about coeducational physical education programs.

4. Sex of the teacher is not a factor in the assignment of instructors to coeducational physical education classes.

5. Certain cultural and historical patterns have influenced coeducational physical education programs at various periods (this aspect of the doctoral study is not reported here because of space limitations).

(Submitted 11/7/58)

The Reliability and Validity of Selected Physical Fitness Tests for High School Girls

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Abstract

The Rogers' Strength Test, the Kraus-Weber Test of Minimum Muscular Fitness, and a battery of motor fitness tests were administered to 169 freshmen, sophomore, and junior girls at Shoreline High School, Seattle, Washington. Each test was administered two or more times in order to investigate the reliability of the tests. The results seemed to indicate that the Rogers' Strength Test and Washington Battery were reliable, that those who scored high on the Washington Battery and on the PFI had a much lower percentage of failures on the Kraus-Weber test than did those with poor Washington Battery and PFI scores, and that there was a moderate correlation (.54) between the Washington Battery and the PFI.

THIS STUDY was an outgrowth of work done by the Washington Women's Fitness Committee.[1] The committee was interested in finding or devising for high school girls a reliable and valid test or test battery which could be administered easily, which did not require expensive equipment, and which did not require highly trained personnel. In reviewing the literature in this field it was found that there were few reports on tests for high school girls and that a small number of these reported reliability and validity coefficients. Taking into consideration the elements of fitness most frequently mentioned in the literature (balance, flexibility, strength, agility, and endurance), the committee selected or modified tests which could be assumed to measure these elements.

The tests originally selected were: curl-ups, Illinois Agility Run, through-the-stick, walking a balance beam, finger touch behind the back, squat thrusts, and pull-ups. Reliability studies conducted at Everett High School, Shoreline High School, Nathan Eckstein Junior High School, and Garrison Junior High School in Walla Walla during 1956–57 indicated that some of these tests should be discarded, that some of them were reliable, and that some of them needed modification and further study.

The present study was undertaken to investigate further this Washington Battery and to study the reliability and validity of certain other tests of fitness.

[1]Members of this committee were: Virginia Brannan, Marion Broer, Birrell Dinnetz, Iona Mowrer, Helen G. Smith, Charlotte Wirth, Mildred Wohlford.

Procedure

During October and November, 1957, the Rogers' Strength Test, the Kraus-Weber Test of Minimum Muscular Fitness, and a battery of motor fitness tests were administered to 48 freshmen, 63 sophomore, and 58 junior girls at Shoreline High School, Seattle. Each test was administered two or more times in order to investigate the reliability of the tests.

Rogers' Strength Tests. These tests were administered according to directions for their use. Graduate students from the University of Washington assisted in giving the tests. These students had been trained and had had previous practice in administering these tests. The battery was administered twice to the high school students with one day between testing periods.

Kraus-Weber Tests. These tests were administered according to directions given by Dr. Kraus. The author, who is certified to give these tests, and Elizabeth Culver, trained by the author, administered all Kraus-Weber tests. Two administrations on alternate days were given.

Washington Fitness Battery. The tests included in this battery were: through-the-stick; pull-ups; curl-ups; squat thrusts; and the Illinois Run.[2] Through-the-stick was administered twice on the same day, two trials of pull-ups were given from two to five days apart, four trials of curl-ups were administered with one week between each trial, three 30-second trials of squat thrusts were given five days apart, and two trials of the Illinois Run were administered on the same day.

Push-Pull Tests. Using the hand dynamometer with the push-pull attachment two trials each of the push and pull were administered on the same day.

Treatment of the Data

Rogers' Strength Test. For trials one and two of the Rogers' Strength tests the Strength Index and the Physical Fitness Index were computed. The reliability coefficient between the Physical Fitness Index of trial one and of trial two was computed. T scales were computed for trial one of the Physical Fitness Index.

Kraus-Weber Tests. The percent of failures for each class and for the total group was computed. A reliability coefficient was not computed because it could be seen from inspecting the results that the test was highly reliable and because a recent study reported reliability coefficients for this test (7).

Washington Fitness Battery. For each class and for the total group reliability coefficients were computed as follows:

> Through-the-stick: trial one with trial two;
> Pull-ups: Trial one with trial two;
> Curl-ups: Trial one with trial two, sum of the first two trials with the sum of the second two trials, trial three with trial four;
> Squat thrusts: Best of the first three trials with the best of the second three three trials, sum of the first three trials with the sum of the second three trials;
> Illinois Run: Trial one with trial two.

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[2]For a description of these tests, see the Appendix.

TABLE 1.—RELIABILITY COEFFICIENTS

	Trials	Freshmen		Sophomore		Junior		Total	
		N	r	N	r	N	r	N	r
Rogers PFI	1 with 2	48	.87	56	.93	53	.93	157	.90
Through-the-Stick	1 with 2	47	.72	59	.79	52	.79	158	.77
Pull-Up	1 with 2	41	.86	53	.85	53	.82	147	.82
Curl-Up	1 with 2	43	.60	50	.86	46	.40	139	.61
	Sum of first two with sum second two	39	.76	44	.77	46	.58	129	.62
	3 with 4	37	.92	43	.73	46	.71	126	.80
Squat Thrusts	Best trial 1 Best trial 2	42	.69	49	.72	51	.64	142	.74
	Sum first three trials with sum second three trials	42	.76	49	.79	51	.70	142	.81
Illinois Run	1 with 2	48	.84	56	.93	53	.88	157	.88
Washington Battery	1 with 2	35	.89	42	.88	50	.87	127	.89
Pull	1 with 2	43	.79	58	.86	54	.82	155	.84
Push	1 with 2	44	.56	58	.77	54	.84	156	.75

TABLE 2.—NUMBER AND PERCENT FAILING THE KRAUS-WEBER TEST OF MINIMUM MUSCULAR FITNESS

Class	Failed	
	N	%
Freshmen	18	40
Sophomores	14	26
Juniors	10	19
Total	42	28

T Scales were computed for trial one of through-the-stick, trial one of pull-ups, trial three of curl-ups, the sum of the scores on trial one of the squat thrusts, and trial one of the Illinois Run. These were totaled to give a total T score for each student for the Washington Battery.

Washington Battery and the Physical Fitness Index. For each class and for the total group the coefficient of correlation between the Physical Fitness Index T score and the total T score on the Washington Battery was computed.

Push-Pull. For each class and for the total group the reliability coefficient was computed for the pull scores and for the push scores using the hand dynamometer with the push-pull attachment.

Rogers' Pull-Up Score and the Pull Score and Rogers' Push-Up Score and the Push Score. For each class and for the total group coefficients of correlation were obtained between the Rogers' pull-up score and the pull score and between Rogers' push-up score and the push score.

Developmental Level. The developmental level of each student was determined on the Wetzel Grid. T scores for these developmental levels were computed. The coefficient of correlation between the developmental level T score and the Physical Fitness Index T score was computed as well as the coefficient of correlation between the developmental level T score and the total T score for the Washington Battery.

Results

Table 1 shows the reliability coefficients obtained on the tests included in this study. Coefficients of correlation obtained indicated that the Rogers' Physical Fitness Index scores, the Illinois Run scores, and the Washington Battery scores were highly reliable. When trials three and four on curl-ups were compared an acceptable reliability was obtained. The sum of the first three trials compared with the sum of the second three trials on squat thrusts yielded a higher reliability coefficient than did the best of the first three trials compared with the best of the second three trials.

Table 2 shows the number and percent of failures by class and by total group on the Kraus-Weber Test of Minimum Muscular Fitness. The 28 percent failure for the total group was lower than that found by Kraus (6) for American children (57.8%) and lower than the results obtained in Iowa by Fox (66%) (4) and by Buxton (65%) (1), and lower than those reported by Kirchner and Glines (5) in Eugene, Oregon (38%).

Further analysis of the data revealed that a far higher percent of the Kraus-Weber failures (38% as compared with 17%) occurred among the lowest one-third on the Physical Fitness Index than among those scoring highest on the Physical Fitness Index. The one-third scoring lowest on the Washington Battery accounted for 43 percent of the Kraus-Weber failures; those scoring in the top one-third accounted for 12 percent of the failures on the Kraus-Weber test. In the lowest group on the two tests, failures occurred on both flexibility and psoas strength. In the high groups all failures were on the flexibility item.

TABLE 3.—CORRELATION COEFFICIENTS BETWEEN PFI AND WASHINGTON BATTERY

Class	N	r
Freshmen	45	.47
Sophomores	53	.73
Juniors	52	.40
Total	150	.54

Table 3 indicates that for the total group a correlation coefficient of .54 was obtained when the Physical Fitness Index was compared with the total score on the Washington Battery. This would seem to indicate that the two tests measured some of the same elements and yet were not measuring entirely the same things.

It was thought that the developmental level on the Wetzel Grid would give an indication of the fitness of the students and that a comparison of scores on the Physical Fitness Index with the developmental level and on the Washington Battery with the developmental level would be one check on the validity of the fitness tests. Table 4 shows the coefficients of correlation obtained. The negative correlations may be explained by the fact that the students who had a high Wetzel Grid developmental level were, for the most part, the heavy girls. Apparently this weight was a handicap both in the Physical Fitness Index and in the Washington Battery. It would seem that the heavier girls were handicapped to a greater degree on the Physical Fitness Index than on the Washington Battery.

TABLE 4.—CORRELATION COEFFICIENTS BETWEEN WETZEL GRID DEVELOPMENTAL LEVEL TOTAL WASHINGTON AND BATTERY SCORE AND BETWEEN DEVELOPMENTAL LEVEL AND ROGERS' PFI

Class	Washington Battery		PFI	
	N	r	N	r
Freshmen	45	—.07	49	—.37
Sophomores	52	—.46	54	—.66
Juniors	52	—.10	52	—.80
Total	149	—.18	155	—.56

In administering the push-up and pull-up tests in the Rogers' Strength Test it was difficult to make certain that the subjects maintained a straight body position at all times. For this reason it was thought that if there were a sufficiently high correlation between push scores obtained with the hand dynamometer in a push-pull attachment and push-ups and between pull scores and pull-ups that the push and pull tests, where the equipment was available, might

TABLE 5.—CORRELATION COEFFICIENTS BETWEEN ROGERS' PULL-UP SCORES AND PULL SCORES AND ROGERS' PUSH-UP SCORES AND PUSH SCORES

	Pull-up with Pull		Push-up with Push	
	N	r	N	r
Freshmen	44	.33	44	.68
Sophomores	54	.36	54	.23
Juniors	52	.36	52	.51
Total	150	.36	150	.41

be used in place of push-ups and pull-ups. Table 5 shows the coefficients of correlation obtained between these tests. While there was a positive correlation between the push and push-ups and between the pull and pull-ups, these correlations were not sufficiently high to permit these tests being used interchangeably. It is interesting to note that Carpenter (2) in 1938 found, for college women, that the push and pull correlated .3497 with chin and dip.

Conclusions

Within the limitations of this study, the following conclusions seem justified:

1. The Rogers' Strength Test was reliable.
2. The Washington Battery was reliable.
3. The .54 coefficient of correlation obtained between the Physical Fitness Index and the Washington Battery would seem to indicate that there was some relationship between the two tests, but that they were not measuring entirely the same things.
4. Those who scored high on the Physical Fitness Index had a much lower percentage of failures on the Kraus-Weber test than did those with poor Physical Fitness Index scores.
5. Those who scored high on the Washington Battery had a much lower percentage of failures on the Kraus-Weber test than did those with poor Washington Battery scores.

References

1. Buxton, Doris. "Extension of the Kraus-Weber Test." *Research Quarterly* 28: 210-17; October 1957.
2. Carpenter, Aileen. "A Critical Study of the Factors Determining Effective Strength Tests for Women." *Research Quarterly* 9: 3-29; December 1938.
3. Cureton, Thomas Kirk. *Physical Fitness Work Book.* St. Louis: C. V. Mosby Company, 1947.
4. Fox, Margaret, and Atwood, Janet. "Results of Testing Iowa School Children for Health and Fitness." *Journal for Health-Physical Education-Recreation* 26: 20, 76; September 1955.
5. Kirchner, Glenn, and Glines, Don. "Comparative Analysis of Eugene, Oregon, Elementary School Children Using the Kraus-Weber Test of Minimum Muscular Fitness." *Research Quarterly* 28: 16-25; March 1957.

6. Kraus, Hans, and Hirschland, Ruth P. "Minimum Muscular Fitness Tests in School Children." *Research Quarterly* 25: 178-88; May 1954.
7. Phillips, Marjorie and others. "Analysis of Results from the Kraus-Weber Test of minimum Muscular Fitness in Children." *Research Quarterly* 26: 314-23; October 1955.

Appendix

Through-the-Stick

The wand is held in front of the body, parallel with the floor, hands wide apart and palms down. In a slightly vertical position, the wand is lowered toward the right foot. The right foot swings around the outside of the wand and the right arm and steps over the wand so that the right leg is between the two hands. The left hand is raised so that the wand passes over the head and behind the back. At the same time the right end of the wand slides over the right hip and between the legs. The subject then stands up and steps back over the wand with the left foot. At the finish the wand is in front of the body with the hands facing forward palms out.

Reverse—The starting position is the finish position just described. The left foot steps over the wand and the wand is returned to the original position.

Score—The number of points given is determined by how much of the stunt is completed. Points are earned as follows: (1) Step over with the right foot; (2) Wand behind the back; (3) Wand over the hips; (4) Step in with the left foot; (5) Wand behind the back; (6) Complete.

Pull-Ups

Equipment—A wand to the center of which is attached a ribbon six inches long.

The subject lies flat on her back on the floor. Two students stand on either side of her in a forward lunge position, one facing in the direction of the subject's head and the other in the direction of her feet. They hold a wand so that it is supported by their forward thighs at the point directly above the subject's shoulders at the height of her full reach. The wand is held so that the students holding it can just see the top of the ribbon and the ribbon hangs straight down (not wrapped over or around the wand). The subject grasps the wand with her palms facing away from her. Keeping a straight line from heels to head, the subject pulls herself upward until her chest touches the ribbon.

Score—The number of pull-ups that can be done.

Curl-Ups

The subject lies on her back, arms crossed in front of her body, hands over her shoulders, knees bent so that her feet are flat on the floor. With her feet supported by her partner, and keeping her arms against her chest, she comes to a sitting position touching her elbows to her knees and returns to the back-lying position.

Score—The number of curl-ups that can be done.

Squat-Thrusts

The starting position is the normal standing position. The subject then moves to a squat position placing both hands on a line marked on the floor. She then extends both legs backward until her body is straight and her legs are completely extended behind her. On each extension her feet must touch the line which has been marked on the floor to indicate the distance of her complete extension. From this position she returns to the squat position and then to a full standing position, touching her partner's hand which is held at a height equal to a completely extended reach for the person being tested.

Score—The number of squat thrusts that can be done in 30 seconds. A squat thrust is counted each time the partner's hand is touched.

Illinois Agility Run[1]

At the starting line, the subject assumes a prone position, hands at the side of the chest. On the signal "ready, go" the subject gets to her feet, runs to the line 30 feet from the starting line, turns, sprints to the starting line, turns left around the end chair, zig-zags left to right around the chairs, makes a right loop around the end chair and zig-zags back, right to left, around the chairs, makes a left turn around the end chair, stride stops at the 30-foot line, reverses and dashes over the finish line.

Score—The time it takes to complete the course; *i.e.,* from the signal "go" until the foot crosses the finish line. Two trials are given and the better time is used as the score.

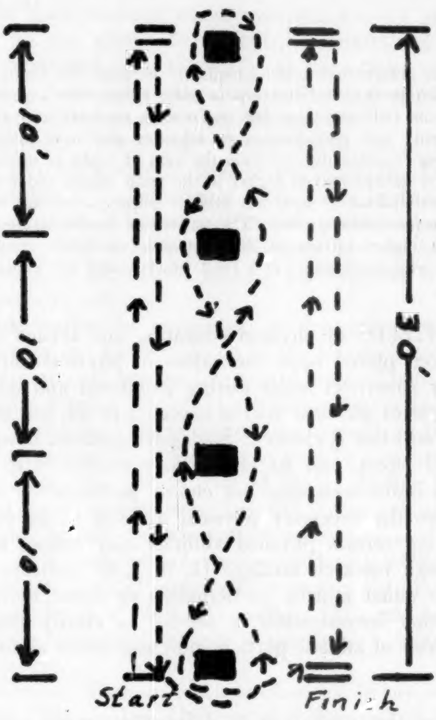

FIGURE I.—The Illinois Agility Run.

[1]Thomas Kirk Cureton, *Physical Fitness Workbook,* St. Louis: C. V. Mosby Company, 1947, p. 24.

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Relationship of Motor Ability and Athletic Participation in Certain Standardized Personality Measures[1]

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Abstract

In an attempt to differentiate more adequately between the terms motor ability and athletic participation in their relationship to some measurable aspects of personality, a group of 167 Pomona College junior and senior male students were classified both as to level of motor ability and participation in athletics and were administered the CPI. Utilizing a total test response derived from the sum of ranks of median scores, low and middle motor ability groups ranked higher in the main effects and within the nonathlete and intramural participation groups, but athletic participation did not appear to have any effect upon the measures studied. The pattern of results suggested an expectation hypothesis wherein higher ratings in the personality inventory might be achieved by groups of subjects who participated at a level which would be "expected" in relation to their motor ability.

WITHIN THE FIELDS of physical education and related disciplines much emphasis has been placed upon the values of physical ability and athletic participation for American males during childhood and adolescence (5, 6, 11). Some degree of physical skill is common to all, but the experience of participation in athletics is elective. Such participation, however, is demanding in time and effort, and its choice may conflict with other interests. Therefore, some individuals may not choose participation in athletics even though they have the necessary physical abilities to be successful; other individuals lacking certain physical abilities may choose to participate in athletics. Although research findings (1, 3, 7, 9) indicate a positive relationship between either athletic participation or motor ability and personal adjustment, further investigation is needed to clarify these relationships when varying levels of athletic participation and motor ability are combined.

Purpose

The purpose of this study was to differentiate more adequately between the terms motor ability and athletic participation in their relationship to some measurable aspects of personality. The data were used to examine the pattern of relationship of selected personality measures to varying combinations of levels of motor ability and athletic participation.

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[1] This study was made in partial fulfillment of the requirements for the degree of Doctor of Education at the University of California at Los Angeles, under the cosponsorship of Ruth Abernathy and Malcolm MacLean.

Particular attention was given to the differences in personality characteristics as measured between groups of subjects with (a) different levels of athletic participation, (b) different levels of motor ability, (c) different levels of athletic participation but with comparable levels of motor ability, and (d) different levels of motor ability but with comparable levels of athletic participation.

Procedures and Subjects

Data were obtained from administering the Larson Test of Motor Ability and the California Psychological Inventory (CPI) to 167 Pomona College junior and senior male students whose previous athletic participation had been classified. All the physically limited, as determined by the college physician, were eliminated from the study, as were those entering Pomona College as transfers from other American collegiate institutions and those who were educated in foreign secondary schools.

Athletic Participation Index. An Athletic Participation Index was constructed to serve as the measure of level of participation. Each subject was classified as nonathlete (N), intramural athlete (I), or varsity athlete (V) on the basis of semesters of interschool athletic participation during junior and senior years in high school and freshman and sophomore years in college, and seasons of intramural athletic participation during freshman and sophomore years in college.

Credit for participation in intramural or interschool (high school or college) athletics required the completion of the playing season as a member of an organized intramural unit or interschool team. Credit for interschool participation did not require playing in any contests or winning any awards. Credit given for intramural participation, recognized at the college level only, required playing in at least half of the possible contests.

Motor Ability Test. The Larson Test of Motor Ability (10), using the weighted standard scores on four tests (baseball throw, pull-up, bar snap, and jump-and-reach) to provide a single battery score, was used as an index of the motor ability of the subjects. A single distribution of the battery scores was divided into three levels of motor ability so that the number of subjects in each of the three levels of high (H), middle (M), and low (L) was the same in order as the number of subjects in varsity (V), intramural (I), and nonathlete (N) groups.

Subject Classification. Each subject was classified in two ways: as having high (H), middle (M), or low (L) motor ability and as being a varsity athlete (V), an intramural athlete (I), or a nonathlete (N). As indicated in Table 1, the two-way classification of subjects with three levels within each classification resulted in nine distinct subgroups: varsity athletes of high (HV), middle (MV), or low (LV) motor ability; intramural athletes of high (HI), middle (MI), or low (LI) motor ability; and nonathletes of high (HN), middle (MN), or low (LN) motor ability.

Low-Low Nonathletes (LLN). Within the group of nonathletes low in motor ability (LN), a subgroup of low-low nonathletes (LLN) was formed

because their measured motor ability was below the scores of subjects in the low motor ability varsity athlete group (LV). In the analysis of data, the low-low nonathletes (LLN) were included when the main effect groups of low motor ability (L) or nonathletes (N) were studied, but the LLN group was treated as a separate cell when internal subgroups were studied. The final distribution within the LN group was 21 low nonathletes (LN) and 16 low-low nonathletes (LLN).

Subjects Description. Descriptive data were gathered from college records and an information blank completed by the subjects. Among the athletic participation groups there were no apparent differences in the descriptive variables studied as to their possible effect on athletic participation and nonparticipation—age, height, weight, marital status, college residence, military service, employment, public and private high school background, and college academic major. Although these variables may have influenced individual subjects in their choice of participation or nonparticipation, there was no over-all effect apparent in the three athletic participation groups. The total group demonstrated high academic potential as measured by College Entrance Examination Board mean scores of 536 and 574 on the verbal and mathematical portions.

Personality Inventory. The California Psychological Inventory (CPI) was administered to each subject (4). The results from each of the 18 standard scales on this instrument were tabulated for all of the internal cells and margin groups shown in Table 1. The 18 inventory scales were Do (dominance), Cs (capacity for status), Sy (sociability), Sp (social presence), Sa (self-acceptance), Wb (well-being), Re (responsibility), So (socialization), Sc (self-control), To (tolerance), Gi (good impression), Cm (communality), Ac (achievement via conformity), Ai (achievement via independence), Ie (intellectual efficiency), Py (psychological-mindedness), Fx (flexibility), and Fe (femininity).

Analysis of Data

MAIN EFFECTS

The main effects of motor ability and athletic participation were studied separately through one-way analyses of variance (2) of the results on each of the 18 scales of the CPI. Thus, low (L), middle (M), and high (H) motor ability groups were examined in one series of analyses; subjects were then classified as nonathletes (N), intramural athletes (I), and varsity athletes (V) for examination in a second series.

Only two of the 36 F values achieved the .05 level of significance. Of the remaining F values, 9 were larger than one and 25 were less than one. The two significant F values represented the number of F values which would be significant by chance in a total of 36 analyses. Therefore, the two significant F values did not have meaning when viewed with the 34 nonsignificant values. It was concluded that the analyses did not demonstrate any relationship between levels of either motor ability or athletic participation

and the separate scales of the CPI. Because of the lack of significance between differences in the main effects, no internal analyses were pursued from this arrangement of data.

TOTAL TEST RESPONSE

Ranking Procedure. As a method of comparing various combinations of groups and subgroups, a total test response was derived by summing the ranks of median scores for each scale on the CPI. Thus, if three groups were to be compared, the group with the highest median score on Do (dominance) was ranked one, the second highest was ranked two, and the lowest was ranked three. This procedure was repeated for each of the 18 scales. The 18 ranks for each group were summed as a measure of total test response. A median rather than a mean score was selected because of the small number of subjects in some of the subgroups.

The high median score was considered the "best" score on every scale except Fe (femininity). The Fe scale was purposely constructed so that the mean score for women would be higher. Therefore, the lowest median score on the Fe scale was ranked one with the other median scores ranked accordingly.

Differences in sums of ranks were studied among groups in each main effect and among subgroups within each row and column as listed in Table 1. This method of internal analysis was to determine if differences in levels of motor ability were the same in different athletic participation groups and if differences in participation groups were the same in different levels of motor ability. The total test response represented a direction which might be significant in spite of a lack of significant differences on individual scales.

Methods of Analysis. The differences in the sums of ranks were analyzed by using the Friedman (X_r^2) two-way analysis of variance by ranks (8). The Friedman test is based upon matched samples tested under several conditions. In the present investigation the groups were considered to be matched on the descriptive variables reported earlier in this paper. In certain of the comparisons the groups were matched as to level of motor ability or athletic participation.

Comparisons within groups indicating significance on the Friedman test were analyzed with the sign test (8). The sign test was used to examine

TABLE 1.—ABBREVIATION SYMBOLS OF GROUPS AND DISTRIBUTION OF SUBJECTS AS TO LEVEL OF MOTOR ABILITY AND LEVEL OF ATHLETIC PARTICIPATION

Level of Motor Ability	Level of Athletic Participation: Nonathlete	Intramural	Varsity	Total
High	HN (11)	HI (16)	HV (34)	H (61)
Middle	MN (13)	MI (16)	MV (16)	M (45)
Low	LN (37)[a]	LI (12)	LV (12)	L (61)
Total	N (61)	I (44)	V (62)	(167)

[a]The low-low nonathletes (LLN) group had 16 subjects and the low nonathletes (LN) group had 21.

TABLE 2.—ANALYSES OF TOTAL CPI RESPONSE DIFFERENCES AS MEASURED BY SUMS OF RANKS OF MEDIAN SCORES

Sums of ranks				df	X_r^2 [a]	p
Main Effects						
	N	I	V			
	35.5	31.0	41.5	2	3.08	n.s.
	L	M	H			
	27.0	33.0	48.0	2	13.00	.01
Athletic Participation						
LLN	LN	MN	HN			
44.5	30.0	49.5	56.0	3	12.22	.01
	LI	MI	HI			
	32.0	31.0	45.0	2	6.78	.05
	LV	MV	HV			
	41.0	30.5	36.5	2	3.08	n.s.
Motor Ability						
LLN	LN	LI	LV			
50.5	37.5	41.5	50.5	3	4.33	n.s.
	MN	MI	MV			
	42.0	28.5	27.5	2	5.25	.10 (n.s.)
	HN	HI	HV			
	43.5	34.0	30.5	2	5.03	.01 (n.s.)

[a]The values listed in this column were computed from Friedman two-way analyses of variance by ranks.

differences between two groups where an over-all test (X_r^2) of differences among many groups had indicated significance, in a manner similar to the use of a t test between two groups where an F test of many groups had indicated that significant differences existed. The sign test makes use of the number of times the median score of one group exceeds the median score of another group.

Results. The results from the Friedman and sign tests, as summarized in Tables 2 and 3, indicated that L and M motor ability groups were ranked significantly higher (had lower sums of ranks) than the H group. There were no significant differences within the subjects when divided into groups of nonathletes (N), intramural athletes (I), and varsity athletes (V).

Within the group of nonathletes, significant differences favored the LN group in comparison with LLN, MN, and HN groups. Within the group of intramural athletes, LI and MI were ranked significantly higher than the HI group. No significant differences were found within L, M, H, or V groups, but M and H motor ability internal group differences approached significance.

TABLE 3.—COMPARISON OF WITHIN GROUP DIFFERENCES USING THE SIGN TEST

Comparisons	N	x[a]	p
Within L-M-H			
L-M	18	6	n.s.
M-H	18	3	.01
L-H	18	3	.01
Within Nonathletes			
LN-LLN	18	5	.05
LN-MN	17	3	.01
LN-HN	18	3	.01
LLN-MN	17	7	n.s.
LLN-HN	17	6	n.s.
MN-HN	17	6	n.s.
Within Intramural Athletes			
MI-LI	16	7	n.s.
MI-HI	18	5	.05
LI-HI	16	3	.02

[a] The value x indicates the number of times the group with the lowest sum of ranks did not exceed the median score of the other group. Based on the 18 scales of the CPI, N should be 18 but ties were discarded. Because the direction of difference was indicated, a one-tailed test was considered appropriate.

Expectation Hypothesis. An examination of the pattern of results on the total test response suggested that higher rankings might be achieved for groups of subjects who participated in athletics at a level which would be "expected" in relation to their motor ability. Thus, a subject of low motor ability would not be expected to participate in athletics, a subject of middle motor ability would be expected to participate in intramural athletics, and a subject of high motor ability would be expected to participate in varsity athletics.

This would lead to the prediction that LN, MI, and HV groups would be ranked significantly higher than other groups of subjects with comparable levels of motor ability or athletic participation. The results of five of six such comparisons favored these groups. Two comparisons indicated significant differences favoring LN and MI; two others approached significance favoring MI and HV. LN was lowest in sum of ranks within the low motor ability group and HV was second in the varsity athlete group, but the differences in sums of ranks were not significant.

The extreme, or "unexpected," groups would be HN and LV. On a total test response comparison of the ten subgroups on each of the 18 scales of the CPI, HN was ranked ten times as eighth, ninth, or tenth, and only once as better than fifth. The LV group was unstable in ranking, being ranked four times as first, second, or third, and nine times as eighth, ninth, or tenth. These rankings would seem to lend support to an expectation hypothesis.

Supplementary Findings. In a further analysis of the data, varsity athletes were divided into individual (tennis, golf, swimming, track, and cross-country) or team (football, basketball, baseball, rugby, soccer, and water polo)

sports groups based on intercollegiate participation during their sophomore year in college. Five subjects participated in both types of competition and were removed from the comparisons. The LV group proportionately had significantly more subjects competing in individual sports than did the MV or HV groups.

The mean raw scores on all scales of the CPI were compared for the individual and team sports groups. Only two of the 18 mean raw score differences were large enough to suspect that they represented significant differences. By inspection it was observed that the median scores of one group were not consistently higher than the other. It was concluded that no real differences or direction of differences existed between varsity athletes classified as team or individual sports participants.

As noted earlier, a subgroup of LLN was formed because these subjects were lower in measured motor ability than any of the intramural and varsity athletes. Some subjects of low motor ability did participate, and others were measured high in motor ability without benefit of participation. Thus, the extreme low motor ability scores of the LLN group, as contrasted to these groups, would seem to indicate that their lack of physical skill was a real barrier to participation in athletics.

Lack of motor ability presents a serious problem in the physical education class where physical skill is requisite for the achievement of some success in performance. It is important to note that a group of subjects was identified as having a lack of motor ability which seemed to be a serious handicap in performing physical activities. In all of the rankings on total test response, the LLN group was in the middle of the sums of ranks.

Summary and Conclusions

In an attempt to differentiate more adequately between the terms motor ability and athletic participation in their relationship to some measurable aspects of personality, a group of 167 Pomona College junior and senior male students, classified both as to level of motor ability and amount of participation in athletics, were administered the California Psychological Inventory.

No significant relationship was found between either motor ability or athletic participation and the 18 separate scales of the CPI. This lack of relationship was directly contradictory to the direction of previous research in which varsity athletes and high motor ability groups were more positively related to personality measures.[2] This would indicate that generalizations concerning the relation of personality characteristics to athletic participation and nonparticipation should be limited to the specific type of group under study.

A total test response derived from the sum of ranks of median scores indicated a differential effect among the main effect motor ability groups and

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[2] Personal conjecture as to the reason for the contradictory findings of the present study as compared to previous research was presented in a paper read at the December 1958 convention of the College Physical Education Association.

among the levels of motor ability within the nonathlete and intramural athletic participation groups. The differences favored the low (L) and middle (M) motor ability groups and low nonathlete (LN), middle intramural (MI), and low intramural (LI) subgroups. Athletic participation did not demonstrate this differential effect among either the main effect groups or among the levels of athletic participation within separate motor ability groups.

The general results of low and middle motor ability groups ranking higher in the main effects and within the participation groups were consistent within this study but were in direct contradiction to expectations from previous research. Athletic participation did not appear to have any effect upon the measures studied, also contradicting previous research.

An examination of the pattern of results on the total test response suggested an expectation hypothesis wherein higher ratings on the personality inventory might be achieved by groups of subjects who participated in athletics at a level which would be "expected" in relation to their motor ability. The a posteriori nature of these observations obviously limits this expectation hypothesis as being a research hypothesis which requires further investigation. It seems possible that further understanding in the study of personality and participation in physical activity may depend upon a more careful consideration of motor ability in relation to the amount of participation.

References

1. Biddulph, Lowell George. *The Relationship of Athletic Achievement to Personal and Social Adjustment in High School Boys.* Unpublished Doctor's thesis. Salt Lake City: University of Utah, 1951.
2. Edwards, Allen L. *Statistical Methods for the Behavioral Sciences.* New York: Rinehart & Co., 1954.
3. Fraleigh, Warren P. "The Influence of Play upon Social and Emotional Adjustment, with Implications for Physical Education." *Proceedings, College Physical Education Association* 59: 268-73; 1956.
4. Gough, Harrison G. *Manual for the California Psychological Inventory.* Palo Alto, California: Consulting Psychologists Press, 1957.
5. Jersild, Arthur T. *The Psychology of Adolescence.* New York: Macmillan Co., 1957.
6. Jones, Harold E. *Motor Performance and Growth.* Berkeley: University of California Press, 1949.
7. McGraw, L. W., and Tolbert, J. W. "Sociometric Status and Athletic Ability of Junior High Boys." *Research Quarterly* 24: 72-80; March 1953.
8. Siegel, Sidney. *Nonparametric Statistics.* New York: McGraw-Hill Book Co., 1956.
9. Sperling, Abraham. "The Relationship Between Personality Adjustment and Achievement in Physical Education Activities." *Research Quarterly* 13: 351-63; October 1942.
10. Weiss, Raymond, and Phillips, Marjorie. *Administration of Tests in Physical Education.* St. Louis: C. V. Mosby Co., 1954.
11. Williams, Jesse Feirling. *The Principles of Physical Education.* Sixth edition. Philadelphia: W. B. Saunders Co., 1954.

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Effect of Warm-Up on the 440-Yard Dash

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Abstract

The purpose of this study was to determine if physical warm-up affects the running time of high school boys participating in the 440-yard dash. A secondary problem was to record injuries, if any, sustained during the experimental period. The study involved 50 pupils over a four-week period. Within the limitations of the study, the following results were apparent: (1) warm-up prior to performing the 440-yard dash did not significantly improve the time over running the same distance without a preliminary warm-up, and (2) no injuries were observed or reported during the testing period.

Review of Literature

PHYSIOLOGISTS have been conducting experiments for several years in an attempt to determine the necessity of warming up prior to engaging in vigorous physical activity. Karpovich (5) found that muscle temperatures below normal decrease muscular irritability and work capacity and that during physical activity muscle temperatures rose; he stated also that there was no experimental proof that warm-up improves muscle function or reduces athletic injury. By contrast, Morehouse and Miller (8) concluded that performance was improved if the muscles were slightly warmed up just before the activity.

Asmussen and Boje (1), using the bicycle ergometer, concluded that a given amount of work could be performed better and and in a shorter period of time when the organism was warmed up by preliminary work. Their subjects were trained athletes and were subjected to large amounts of work, 660 KgM/M for 30 minutes, as a warm-up. Subjects' body temperature was raised also by passive heating with diathermy and hot water, resulting in improved ergometer performance.

Karpovich and Hale (6) performed three series of experiments. Seven trackmen ran 440-yards after deep massage, exercise, and digital stroking. Five men ran 440-yards without warm-up after digital stroking. Three subjects took sprint rides on the bicycle ergometer after preliminary exercise and without warming up. They concluded that none of the warming devices improved time in running the 440, or performance on the bicycle ergometer.

Supporting Karpovich and Hale is a study by Skubic and Hodgkins (11) conducted with 31 women physical education majors as subjects. The women performed three tests: for speed, they rode 1/10 mile on a bicycle ergometer, for strength, they threw a softball for maximum distance, and for accuracy, they scored as many basketball free throws out of ten attempts as possible. Each test was performed preceded by no warm-up, preceded by a general warm-up and preceded by a warm-up related to the test activity. Their results showed no significant differences in the scores made in relation to the three types of warm-up procedures. They also recorded no injury or soreness during the testing period.

Hipple (4) tested ten eighth grade boys running sprints. After dressing and walking to the testing area, the subjects ran in pairs, running the course five different times. Ninety percent of the fastest runs were distributed equally among the first three trials. Runs ranked two and three were distributed almost equally among the first four trials. Hipple concluded that the first race had no beneficial warm-up effect on the second

race and that cumulative warm-up of the first and second races had no beneficial effect on the third race. The fourth and fifth races were a little slower probably because of fatigue.

Pacheco (10) tested ten experienced college subjects, nine men and one woman, in five or more groups of six trials on the standardized vertical jump, under each of four conditions. Compared to the nonwarm-up control group, deep knee bends improved performance 2.88 percent, isometric stretching improved performance 4.99 percent, and stationary running improved performance 7.80 percent. All these differences were statistically significant. In a second experiment using 50 college men as subjects, performance in the vertical jump improved 3.27 percent after preliminary knee bends. The increased performance in this test was highly significant.

Testing the importance of warming up before competitive swimming, Carlile (2) offered results that showed improvement in performance over 220 yards of 1.5 percent following eight-minute hot showers. Also, ten swimmers in 230 trials with various strokes, showed an improvement of 1 percent for 40-yard time trials when the swims were preceded by eight-minute hot showers. A statistical consideration of the group data showed the difference in swimming speed between control and preheated swims to be highly significant.

Michael, Skubic, and Rochelle (7) tested 77 college men throwing a twelve-inch softball three times for distance with no preliminary warm-up, with a preliminary five-minute nonrelated general warm-up, and with a preliminary five-minute related throwing warm-up. The results revealed that both types of warm-up resulted in significantly longer throws and that the time spent and strenuousness of the warm-up appeared to be factors involved in improving the distance balls were thrown. Differences were statistically significant beyond the 1 percent level of probability.

Medical doctors have commented on the findings of Karpovich and Hale. Gillett (3) reasoned that track men do not exert sudden maximum muscular power in the space of a split second, as do weight lifters and basketball and baseball players. He concluded that "if coaches did away with the warm-up ritual, sports injuries would rise considerably" (9). Trotter (12) denounced the Springfield study on the basis that the testing was conducted with mediocre track men in an uncompetitive situation. Woodard (13) stated: "One cause of torn muscles is the habit of taking strenuous exercise suddenly and in an unaccustomed way when the muscles are not tuned up . . . . The average runner requires from 20 to 30 minutes of steady regular exercise."

An article typical of many that appeared in national coaching periodicals stated: "Perhaps no other man on your (track) team needs more careful preparation than your quarter miler. He is very foolish to go to his marks without being as nearly ready for all-out effort as possible" (9).

Problem

The purpose of this study was to determine if physical warm-up affects the running time of high school boys participating in the 440-yard dash. A secondary problem was to record injuries, if any, sustained during the experimental period.

Procedure

The data for this study were secured from sophomore physical education pupils enrolled at West Valley High School in Spokane, Washington. This group of 54 pupils with limited track experience was tested during May of the 1956–57 school year. The running times of the subjects were recorded in seconds and in tenths of seconds.

The testing was distributed over two consecutive class periods using 27 subjects from each class. Prolonged illness of four boys necessitated their with-

drawal from the study leaving a total of 50 subjects. The boys were divided alphabetically into groups of five for performing the dash. To justify this classification, it was assumed that the subjects were nearly equal in experience, since any boy who was participating in varsity track was eliminated from the study. It was further assumed that the subjects were in approximately the same physical condition since the testing took place the last month of the school semester, and all subjects had been in an activity class, daily, for three and one-half months.

The experiment was conducted the first four days of each week and continued over a period of four weeks. The fifth day of each week was used for a variety of other activities in an attempt to keep the subjects from becoming bored with the experiment. Since there were two groups of 25 subjects, during the first hour of each day of the first week, the control group was comprised of 15 subjects while there were 10 subjects in the experimental group. For the second hour, 10 subjects would comprise the control group and 15 the experimental group. Hence at the conclusion of the testing day, 25 subjects had run as the control group and 25 as the experimental group. The second week this procedure was reversed so that those subjects who had comprised the control group became the experimental group and those subjects in the experimental group moved to the control group. The third and fourth weeks were a repeat of weeks one and two. Thus each subject ran the 440-yard dash as a control (warm-up) two times each week and twice each week in the experimental group (no warm-up). Therefore, a given subject ran the dash sixteen times, eight as a member of the control group and eight times representing the experimental group.

The subjects who were to perform in the experimental group dressed, walked to the track, and sat down until their group was called upon to run. The subjects who were to participate in the control group dressed, reported to the track, and, under the supervision of a varsity track man, completed the following.

1. One lap (440 yards) jogging and walking alternately
2. Six push-ups
3. Six leg pulls (knee to chest) with each leg
4. Ten toe touches
5. Six sit-ups
6. Three ten-yard wind sprints
7. Five to ten minutes of rest

Recording the Times. Running times were recorded on a 30-second watch. Two stop watches were used by the investigator in case of an operational failure. Five boys, enrolled in the class but eliminated from the study because they were participating in varsity track, were employed as time recorders. Each time a recorder was assigned one subject for whom he would compute time. The investigator would call times in seconds and tenths when the first subject crossed the finish line until the fifth subject crossed, at which occasion

he would stop the watches. The next five subjects would then run and the procedure would be repeated.

Preliminary Organization of the Data. As the experiment lasted one month, several absences occurred which resulted in only three scores instead of four for a few of the subjects. In reporting the times it was decided to average the three fastest of four times recorded by each subject each week, to arrive at a running time for that week. In the case of two absences, the scores available were averaged. Each subject was credited with four running times: the first time he ran "warm," the first time he ran "cold," the second time he ran "warm," and the second time he ran "cold."

Analysis of Data. The *t* test was used to determine whether a significant difference resulted between running with a warm-up (control) as opposed to running without a warm-up (experimental). To obtain significance with an N of 50 for the .05 and .01 levels of confidence, the *t* must equal 2.02 and 2.69 respectively. In order to determine the consistency in running the 440-yard dash, the average times for each of the two trials were correlated.

Results and Analysis of Data

Statistical comparisons were made between: (1) the means for the first and second trials the subjects ran warm; (2) the average time trials resulting from the first and second performances by the subjects when they ran cold; (3) the first time the subjects ran warm and the first time the subjects ran cold; and (4) the second time the subjects ran warm and the second time they ran cold.

The coefficient of correlation between the first and second trials for the control group indicated a fairly high degree of reliability, .77. A *t* of 1.72 indicates that no significant difference between the means of the control groups exists when the first and second trials are compared. The data are contained in Table 1.

TABLE 1.—COMPARISON OF MEAN TIMES OF WARM-UP GROUP FOR FIRST AND SECOND TRIALS

Trial	Mean (seconds)	Difference Between Means		
		Diff.	S.E. Diff.	t
I	73.22			
II	74.34	1.12	.65	1.72

The times of the experimental group for the first trial ranged from 62.6 to 86 seconds, with a mean of 72.62; the standard deviation was 5.52. The times for the second trial ranged from 61.8 to 84.3, with a mean of 73.70; the standard deviation was 6.08. The coefficient of correlation between the first and second trials of the experimental group yielded a *r* of .64. Statistical comparison revealed a *t* of 1.54, indicating no significance in the differences of the means between the first and second trials of the experimental group. The data are contained in Table 2.

TABLE 2.—COMPARISON OF MEAN TIMES OF EXPERIMENTAL GROUP FOR FIRST AND SECOND TRIALS

Trial	Mean (seconds)	Difference Between Means		
		Diff.	S.E. Diff.	t
I	72.62			
II	73.70	1.08	.7028	1.54

The times of the first trial for the control group ranged from 62.5 to 88.3, with a mean of 73.22; the standard deviation was 6.26. The times of the first trial for the experimental group ranged from 62.6 to 86, with a mean of 72.62; the standard deviation was 5.52. The coefficient of correlation between the first trial of the control group and the first trial of the experimental group was .80. Statistical comparison also showed a *t* of 1.01 which falls far short of significance. The data are contained in Table 3.

TABLE 3.—COMPARISON OF MEANS BETWEEN FIRST TRIAL OF CONTROL GROUP AND FIRST TRIAL OF EXPERIMENTAL GROUP

Group	Mean (seconds)	Difference Between Means		
		Diff.	S.E. Diff.	t
Control	73.22			
Experimental	72.62	.60	.54	1.01

The times of the second trial of the control group ranged from 61.4 to 90.5, with a mean of 74.34; the standard deviation was 7.04. The times of the second trial of the experimental group from 61.8 to 84.3, with a mean of 73.70; the standard deviation was 6.08. The coefficient of correlation between the second trial of the control group and the second trial of the experimental group was the highest in the study, .86. Statistical comparison also indicated a *t* of 1.24, which is not significant. The data appear in Table 4.

TABLE 4.—COMPARISON OF MEANS BETWEEN SECOND TRIAL OF CONTROL GROUP AND SECOND TRIAL OF EXPERIMENTAL GROUP

Group	Mean (seconds)	Difference Between Means		
		Diff.	S.E. Diff.	t
Control	74.34			
Experimental	73.70	.64	.5153	1.24

Conclusion

Within the limitations of this study the following results were apparent:

1. Warming up prior to performing the 440-yard dash did not significantly improve the time over running the same distance without a preliminary warm-up.
2. No injuries were observed or reported during the testing period.

References

1. ASMUSSEN, ERLING, and BOJE, OVE. *Body Temperature and Capacity for Work.* Stockholm: P. A. Norstedt and Loner, 1945.
2. CARLILE, FORBES, "Effect of Preliminary Passive Warming on Swimming Performance." *Research Quarterly* 27: 143-51; May 1956.
3. GILLETT, ROBERT L. "Correspondence." *Journal of the American Medical Association* 163: January 1957.
4. HIPPLE, JOSEPH E. "Warm-Up and Fatigue in Junior High School Sprints." *Research Quarterly* 26: 246-47; May 1955.
5. KARPOVICH, PETER V. *Physiology of Muscular Activity.* Philadelphia: W. B. Saunders Co., 1953.
6. KARPOVICH, PETER V., and HALE, CREIGHTON J. "Effect of Warming-up Upon Physical Performance." *Journal of the American Medical Association* 162: November 1956.
7. MICHAEL, ERNEST; SKUBIC, VERA; and ROCHELLE, RENE. "Effect of Warm-Up on Softball Throw for Distance." *Research Quarterly* 28: 357-63; December 1957.
8. MOREHOUSE, LAURENCE E., and MILLER, AUGUSTUS T. *Physiology of Exercise.* St. Louis: C. V. Mosby Company, 1948.
9. O'CONNOR, W. HAROLD. "Warm-Up As an Aid to Track Performance." *Scholastic Coach* 25: November 1955.
10. PACHECO, BETTY A. "Improvement in Jumping Performance Due to Preliminary Exercise." *Research Quarterly* 28: 55-63; March 1957.
11. SKUBIC, VERA, and HODGKINS, JEAN. "Effect of Warm-Up Activities on Speed, Strength, and Accuracy." *Research Quarterly* 28: 147-52; May 1957.
12. TROTTER, YATES, JR. "Correspondence." *Journal of the American Medical Association* 163: March 1957.
13. WOODARD, CHRISTOPHER. *Sports Injuries.* London: Max Parris, 1954.

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Functions of a School Nurse

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Abstract

This study identified and analyzed the functions of a nurse working in the school, according to frequency, importance, and complexity. Time spent and time recommended to be spent were calculated. Factors affecting the performance of the functions were explored. The 132 functions were evaluated by 686 nurses in Ohio, Illinois, Michigan, and Wisconsin. Tabulations were made as to population, type of schools, and employer. Results indicate that there was a general agreement in the performance of the functions between the groups and that total situations should be considered rather than isolated functions.

DIFFERENCES OF OPINION have existed for many years regarding the functions of a nurse working in the school health program. The majority of the suggestions made concerning the functions of the nurse have been based on limited research study. Even though many articles and books have touched briefly on portions of this area, more objective and scientific studies are needed.

Purpose

The purpose of this study was to identify the functions of a nurse as perceived by the nurses working in the school health program and to analyze the functions according to their perception of frequency, importance, and complexity. This study was to calculate the perceived time spent and recommended to be spent in performing the functions and to discover the factors that were thought to affect the execution of the functions. Although changes were made in the study, such as the elimination of analyzing the complexity of the functions, they did not alter the original purpose.

By evaluating and defining the functions of a nurse in the school, curriculum construction for nurses' training programs may be more skillfully planned. School administrators, public health department personnel, teachers, parents, and pupils may all benefit from the definition of the functions of a nurse in the school. Also, the identification of these functions will aid the nurse in the school to achieve more useful goals.

Definition of Terms

Function. A function in this study was interpreted to mean the proper action or special activity of a school nurse.

Categories. The term is used to indicate groupings or divisions formed by the nature of the function. Categories in this dissertation are for the purpose of classifying functions.

Frequency. This is to be interpreted as the number of times the function is performed. In this particular study, frequency refers to how often the individual school nurse performs a function. The rating scale distinguishes between a function which is not performed and one which is performed. It classifies the performed functions as those executed once or twice a year, approximately monthly, seasonally (concentrated in a certain part of the year), and approximately daily, weekly, or more often.

Importance. Throughout the study the term shall refer to how essential the nurse considers the function. It is suggested that the nurse consider her position as being in a school where she is required to perform the function. The ratings range from "no importance" to "highest or utmost degree of importance."

Complexity. The term is used in this dissertation to describe how difficult the individual nurse considers the function for a nurse who is performing it for the first time. The ratings range from "no complexity" to the "highest or utmost degree of complexity."

School Nurse or the Nurse Functioning in the School Health Program. These terms shall be interpreted as meaning a person employed by the board of education, the public health department, or by other organizations for the purpose of aiding the school in meeting its health obligations.

Review of Literature

Many references were helpful in providing either excellent background material or an increasing understanding of nursing philosophies and procedures. A brief summary of the references which were specifically useful in this study is given below:

Swanson (7) discussed the role of the school nurse in the community and the school and the planning of her work. The book emphasized the nurse's part in individual appraisal, health supervision, education, and special situations. One chapter dealt with the selection of activities of the nurse.

Bland (1) investigated and analyzed the activities of 172 Indiana public school nurses employed by the board of education. The purpose of the study was to improve nursing services to the school and community, to define the role of the nurse in the school, and to study the outcome of the licensure requirements.

Grossman (3) made a study of school nursing problems and their implications for professional education in three counties in California. Sixty-five nurses hired by boards of education or public health departments discuss school health nursing problems.

A report of the Joint Committee on Health Problems in Education of the National Education Association and the American Medical Association (5) emphasized the importance of administrative leadership and the need for a description of policies and duties of the school nurse. Health obligations of the school and the relationship with other individuals in the home, school, and community were listed here. Policies dealing with health responsibilities of the school and functions of the nurse were suggested with reference for adaptation to various types of schools.

A report of a conference under the direction of the National Conference for Cooperation in Health Education (4) stated the functions and education of the school administrator, physician, and nurse.

A committee of nurses of the American School Health Association (2) assembled a guide for school nurse policies and practices. It suggested gen-

eral recommendations which might be used to construct local guides. The guide included the general and specific responsibilities, qualifications, pupil load, and supervision of the school nurse.

Rappaport (6) pointed out in her article that co-operation of the nurse and teacher is important in a health program. She presented questions to be considered by the nurse and the teacher in order that workable policies can be formulated. Attention was given to pupil needs, pupil load, public relations, health appraisal, health environment, and health instruction.

Procedure

A modified job analysis technique was used. It was selected because it seemed to be easy for the respondents to understand and check the ratings. It was simple to score, low in cost, and less time-consuming than some of the other methods, such as interview.

The research for this study involved four phases: phase one was the compilation and classification of the functions of a school nurse; phase two was the construction of a desirable rating scale for evaluating the functions; phase three was the selection and procurement of data for analysis; phase four was the analysis of data secured and the formulation of final conclusions regarding the proper functions of a school nurse.

Introspection, documentary analysis, personal interviews, observation, and a study of related literature were used to develop a list of functions. The functions were classified and a committee composed of school nurses, public health nurses and supervisors, and university instructors from a school of education and a school of nursing helped to add, delete, clarify, and suggest ideas for completing the list of functions.

From this, a tentative rating scale was developed and submitted to three nurses and a health educator for criticism. Their suggestions helped to refine and clarify the functions and the procedure for the next research instrument.

A second rating scale was then developed and a pilot study was made. The participants were five nurses who served the schools in small, medium, and large communities.

Four states in Region V, as designated by the United States Public Health Service, were selected for the final study: Illinois, Michigan, Ohio, and Wisconsin. Personnel from the State Department of Education and Nursing in the four states were interviewed. They suggested methods of improvement, provided marked state lists of nurses functioning in the school, and furnished letters to encourage the study.

After the pilot study and the state interviews, the research instrument was again revised and the final rating scale was developed.

At this time, the selection of participants within the four states was made. Five population groups were specified: 0–2,500; 2,500–10,000; 10,000–30,000; 30,000–100,000; 100,000 and over. Of those nurses in each population group who were hired by boards of education, only 50 percent were sent rating scales, and of those nurses in each population group who were employed by other organizations to serve the school, only 50 percent were sent

rating scales. The results were that instruments were sent to 1287 school nurses; 403 were hired by boards of education and 884 were employed by other organizations. It was thought that by designating these specific groups returns could be compared according to population and employer.

Participants were asked to give identification data; to rate 132 functions for the criteria of frequency, importance, and complexity; and to designate factors that were thought to affect the performance of the functions by checking problem areas and recommending needed educational and clinical experiences. A space was provided for the nurse to estimate time spent and time recommended to be spent for each of the ten categories of functions.

Presentation of Data

Of the 686 research instruments that were returned, only 610 were usable. Returns were put into population groups but separated according to employer and types of schools which the nurse served: employers were designated as board of education or other organizations; types of schools were divided according to elementary, secondary, or a combination of the two. Table 1 shows the number of usable returns grouped according to type of school, employer, and population of the community.

When the number of returns were 20 or more within one of the groups listed in Table 1, a separate table was made. Hence, 98 of the 610 usable returns were not tabulated. Ten separate tables were constructed. Only one, Table 2, is included here because of space limitations.[1]

TABLE 1.—NUMBER OF USABLE RETURNS MADE BY SCHOOL NURSES IN RELATION TO POPULATION, TYPE OF SCHOOL, AND EMPLOYER

Population	Employed by Other Organizations			Employed by Boards of Education		
	Grade and High School	Grade School	High School	Grade and High School	Grade School	High School
0- 2,500	0	0	0	7	2	1
2,500- 10,000	17	1	0	36	9	3
10,000- 30,000	57	11	2	31	9	9
30,000-100,000	119	44	4	28	20	9
100,000-and over	94	61	2	22	9	3

In each table, functions were listed in rank order within each of the ten categories of functions according to the frequency responses of those performing the activity. The number performing each function and the percent of those responding in regard to each function were recorded. The number and percent of respondents who considered the functions highly important were stated.

(*Text is continued on page 460*)

[1]All ten tables are included in the author's doctoral dissertation (Poe, Nancy M., *Functions of a School Nurse*. Doctor's thesis. Boston: Boston University, 1957).

TABLE 2.—RANK ORDER OF NURSES PERFORMING EACH FUNCTION, PERCENT WHO RESPONDED IN REGARD TO EACH FUNCTION, AND NUMBER AND PERCENT WHO CONSIDERED THE FUNCTION TO BE OF HIGHEST IMPORTANCE, EMPLOYED BY BOARDS OF EDUCATION IN ELEMENTARY AND SECONDARY SCHOOLS IN COMMUNITIES OF 10,000–30,000

Function	NP =	%P =	NI =	%I =
I. *Policy and Planning Functions*				
1. Develop co-operative relationships between the school nurse and the school personnel	31	100	29	94
2. Help develop and/or revise school health policies, procedures, and standing orders	31	100	22	71
3. Co-operate with guidance personnel in the use of health materials and information	31	100	21	68
4. Carry out laws of the state and federal government pertaining to health as they affect the school child and the school	30	97	24	77
5. Assist with the organization of special programs (i.e., X-rays, dental, etc.)	30	97	18	58
6. Inform school personnel of recommended functions, standards, and qualifications of the school nurse	26	84	17	55
7. Serve on school committees	26	84	11	35
8. Assist in planning and conducting preschool round-ups, immunizations, etc.	24	77	19	61
9. Work to establish and be a member of a school health council or planning group	23	74	15	48
10. Co-ordinate health programs with other departments (i.e., science, cafeterias)	23	74	10	32
11. Hold orientation conferences with new teachers concerning the health programs	21	68	16	52
12. Assist in developing a means whereby the school health program is evaluated	21	68	13	42
13. Assist in the planning of new facilities	20	65	12	39
14. Work with teachers' groups in curriculum analysis and revision	17	55	6	19
15. Assist in organizing and conducting inservice health educational programs for school personnel	14	45	11	35
16. Participate in planning the budget of the department	9	29	8	26
17. Supervise nursing students in school nurse field work	6	19	12	39
18. Supervise student teaching experiences in health education	5	16	11	35
II. *Recording and Reporting Functions*				
1. Interpret health records	31	100	18	58
2. Perform duties related to office routine including correspondence and clerical duties	31	100	8	26
3. Assist in establishing and maintaining an adequate system for keeping school health records	30	97	18	58
4. Prepare reports for the school administrator	30	97	12	39
5. Prepare announcements, bulletins, and publicity	30	97	11	35
6. Prepare special information reports, i.e., immunization, vaccination, incident of disease	30	97	7	23
7. Assist or make annual and/or monthly reports	29	94	13	42
8. Analyze health reports to determine the value of past procedures and future plans	29	94	13	42
9. Keep a daily activity record book containing professional services of the school nurse	26	84	15	48
10. Secure health records of transfer students	26	84	13	42
11. Prepare special case reports, (i.e., T.B., orthopedic)	25	81	10	32
12. Prepare accident reports	16	52	10	32
13. Organize, revise, and plan for the daily health observation records of the classroom teacher	12	39	4	13
III. *Inservice and Professional Functions*				
1. Attend lectures, discussions, clinics, and workshops related to health problems	31	100	13	42
2. Participate in professional organizations	31	100	11	35
3. Address groups concerning health topics	30	97	10	32
4. Assist in preparing information concerning communicable and noncommunicable diseases for parents and teachers	28	90	14	45
5. Do independent study for professional growth	25	81	18	58
6. Perform self-evaluation of professional activities	25	81	13	42
7. Write articles for professional magazines, journals, and newspapers	1[illegible]	52	3	10
8. Participate in inservice staff education for nurses	15	48	11	35
9. Assist in preparing programs for radio and T.V.	10	32	2	6
10. Edit textbooks or other materials for publications	8	10	2	6

Function	NP	%P	NI	%I
IV. *Instructional Functions*				
1. Help teachers with materials and aids for health units	30	97	12	39
2. Demonstrate health measures to teachers, i.e., first aid, inspection	27	87	13	42
3. Assist in teaching classes when asked by the teacher	26	84	8	26
4. Serve in an advisory capacity in the health instruction program	24	77	12	39
5. Help to develop activities which will promote safety	21	68	12	39
6. Participate in orientation program (i.e., explaining, preparing pupils) for health examinatons	21	68	11	35
7. Help in the selection of audio-visual aid material for health education	20	65	8	26
8. Assist in the selection of health education books and booklets to be purchased by the library	17	55	7	23
9. Teach home nursing	9	29	5	16
10. Teach first aid	6	19	9	29
11. Teach scheduled health courses in the school curriculum	4	13	9	29
V. *Healthful School Living Functions*				
1. Observe unsafe or unsanitary conditions in building, grounds, and equipment, and report to responsible school personnel	29	94	18	58
2. Assist in arranging for resting facilities for students	25	81	7	23
3. Assist in environmental survey with administrator, school physician, and/or sanitarian	15	48	11	35
4. Assist in the school seating adjustment program	15	48	4	13
5. Help to evaluate heating, lighting, and ventilation in the school	14	45	8	26
6. Help regulate the sale of candy, soft drinks, etc., in the school	12	39	11	35
7. Aid in planning the school day with reference to the needs of teachers and students	12	39	7	23
8. Assist in the planning of a physical education and recreational program	8	26	4	13
9. Assist in planning and evaluating the school lunch program	7	23	7	23
10. Assist in the inspection of the storing, preparation, and handling of food	3	10	8	26
VI. *Medical Examination—School Health Service Functions*				
1. Give visual acuity tests	29	94	17	55
2. Secure or assist teacher in securing health history through parent interview or questionnaire	27	87	16	52
3. Give audiometric tests	24	77	16	52
4. Give health screening retests	22	71	10	32
5. Arrange for teachers to weigh and measure students	21	68	9	29
6. Make dental inspections	20	65	8	26
7. Arrange for and assist with the school health examination	17	55	13	42
8. Invite parents to be present at the health examination of their children	16	52	17	55
9. Arrange for a consultant or technician to give health screening tests	16	52	11	35
10. Report health observations to the school physician before the health examination	14	45	9	29
11. Arrange for examination for participants in the extracurricular athletic program	14	45	6	19
12. Give ocular muscle tests	10	32	5	16
13. Arrange for volunteers to give health screening tests	10	32	4	13
14. Assist teachers in vision testing	8	26	4	13
15. Give color vision tests	8	26	4	13
16. Arrange for preemployment examination for school personnel	7	23	13	42
17. Assist substitute teacher in giving health screening tests	5	16	4	13
VII. *Follow-Up School Health Service Functions*				
1. Interview parents in regard to their child's health defects	31	100	27	87
2. Review health records and follow-up cases as indicated	31	100	25	81
3. Inform teacher of physical defects of the child	31	100	25	81
4. Hold nurse-teacher conferences	31	100	24	77

Function	NP	%P	NI	%I
5. Assist in making referrals to community resources and agencies	31	100	23	74
6. Record on health records verification of treatment	31	100	21	68
7. Assist teachers with students who have behavior problems	31	100	16	52
8. Notify the school personnel (or vice versa) about home conditions which may affect the child	30	97	26	84
9. Telephone and/or write notices of defects to parents	30	97	24	77
10. Confer with appropriate agencies on neglect cases	30	97	22	71
11. Assist in arranging with parents for specialist examination	30	97	22	71
12. Help secure special education for handicapped children	29	94	23	74
13. Assist in communicable disease control	29	94	21	68
14. Establish use of health records by teachers	28	90	16	52
15. Assist in dealing with parents who refuse to secure for students treatment required by law	26	84	11	35
16. Assist in planning a school program for the handicapped child	25	81	19	61
VIII. *Emergency School Health Service Functions*				
1. Have teachers or principal administer first aid for minor injuries	31	100	21	68
2. Call or have principal call family physician when parents or guardians cannot be reached in an emergency	30	97	25	81
3. Contact or have principal contact parents and have them come or send for ill or injured student	30	97	24	77
4. Assist in securing first aid equipment and medical supplies	30	97	20	65
5. Arrange a first aid station	30	97	20	65
6. Administer first aid to seriously injured or ill student	30	97	19	61
7. Supervise or have school personnel supervise ill, injured, or isolated students at school	30	97	18	58
8. Report or have principal report a dog or other animal bite to public health department or police department	29	94	25	81
9. Have first aid texts and emergency instructions available at stations, in nurses' room, etc.	29	94	23	74
10. Explain emergency instructions to school personnel, parents, and teachers	28	90	23	74
11. Keep up-to-date records in order to know where and to whom to send or have principal send student in case of an emergency	27	87	24	77
12. Analyze accidents as basis for safety program	19	61	17	55
13. Assist in instructing school personnel in regard to civil defense, hurricane, or other emergency measures	10	32	12	39
IX. *Day-by-Day School Health Service Functions*				
1. Promote early detection of remedial health problems	31	100	24	77
2. Assist in finding children with special needs	31	100	23	74
3. Assist school personnel in detecting students who need referral to the school nurse	31	100	23	74
4. Assist in advising the exclusion from school of an ill child	31	100	21	68
5. Investigate the absence of students because of prolonged illness	31	100	20	65
6. Inspect and interview pupils referred by teachers	31	100	18	58
7. Help teacher to observe for signs of communicable and noncommunicable diseases	30	97	24	77
8. Secure parents' or guardians' consent for immunization, tests, etc.	28	90	26	84
9. Assist in reporting communicable diseases to health officer	27	87	10	32
10. Educate parents to report illness of children on the first day of absence from school	25	81	16	52
11. Assist in notifying parents when children have been exposed to communicable diseases	23	74	13	42
12. Re-admit students after illness or exclusion	21	68	9	29
13. Interview new students	19	61	8	26
14. Assist teachers in detecting possibile narcotic addicts	8	26	15	48

Function	NP	% P	NI	% I
X. *Community Relations Functions*				
1. Assist family in using community health resources and agencies to work out student's health problems	31	100	20	65
2. Make home visits	30	97	27	87
3. Participate in arranging a two-way communication between the school and the family physician	26	84	22	71
4. Serve on community health committees	26	84	13	42
5. Work to expand community health facilities	24	77	18	58
6. Participate in community promotion of child safety	23	74	16	52
7. Conduct meetings pertaining to health problems or information in the school and the community	22	71	11	35
8. Investigate geographic, social, economic, religious, and political conditions of the community	15	48	6	19
9. Assist in community health survey	14	45	11	35
10. Investigate the mortality, morbidity, and birth-rates of the community	8	26	5	16

Key:
NP = Number performing
%P = Percent performing
NI = Number who considered function to be of highest importance
%I = Percent who considered function to be of highest importance

TABLE 3.—MEAN PERCENTAGES OF TIME SPENT AND RECOMMENDED SPENT FOR MORE EFFECTIVE PERFORMANCE OF THE MAJOR CATEGORIES OF FUNCTIONS, FOR NURSES SERVING SCHOOLS, EMPLOYED BY ORGANIZATIONS OTHER THAN THE BOARDS OF EDUCATION, IN THREE POPULATION GROUPS.

Major Categories of Functions	10,000-30,000	30,000-100,000		100,000 & over		
	C	C	E	C	E	Time
Policy and Planning	7	7	5	7	4	Spent
	7	7	6	9	3	Rec.
Recording and Reporting	11	16	11	15	20	Spent
	11	8	8	10	8	Rec.
Inservice and Professional	5	6	5	5	4	Spent
	5	7	7	6	7	Rec.
Instructional	9	5	6	7	6	Spent
	8	8	8	8	14	Rec.
Healthful School Living	4	3	3	3	3	Spent
	5	5	6	5	5	Rec.
Medical Examination	23	10	12	10	15	Spent
	22	11	11	10	12	Rec.
Follow-Up	17	24	24	25	21	Spent
	23	27	26	25	23	Rec.
Emergency	4	3	4	3	4	Spent
	4	3	4	3	4	Rec.
Day-by-Day	12	17	30	14	17	Spent
	15	15	18	12	9	Rec.
Community Relations	8	7	6	9	5	Spent
	10	12	7	11	12	Rec.

Key: C = Elementary and Secondary; E = Elementary

TABLE 4. MEAN PERCENTAGES OF TIME SPENT AND RECOMMENDED SPENT FOR MORE EFFECTIVE PERFORMANCE OF THE MAJOR CATEGORIES OF FUNCTIONS, FOR NURSES SERVING THE SCHOOL, EMPLOYED BY BOARDS OF EDUCATION, IN FOUR POPULATION GROUPS.

Major Categories of Functions	2,500-10,000	10,000-30,000	30,000-100,000		100,000 & over	Time
	C	C	C	E	C	
Policy and Planning	5	9	4	4	5	Spent
	6	9	6	6	6	Rec.
Recording and	12	10	13	18	15	Spent
Reporting	8	7	8	12	9	Rec.
Inservice and	4	5	5	4	6	Spent
Professional	7	7	7	7	8	Rec.
Instructional	6	4	6	4	5	Spent
	6	9	9	7	8	Rec.
Healthful School	4	4	6	3	3	Spent
Living	6	7	7	7	4	Rec.
Medical Examina-	12	12	13	18	21	Spent
tion—School	12	15	11	17	20	Rec.
Follow-Up	14	16	15	21	19	Spent
	19	18	20	22	18	Rec.
Emergency	14	9	9	5	6	Spent
	8	7	7	5	5	Rec.
Day-by-Day	26	22	24	20	16	Spent
	22	15	20	15	16	Rec.
Community Relations	5	8	6	6	6	Spent
	9	7	8	8	7	Rec.
Hours Per Week Spent on Job	40	41	39	39	36	

Key: C = Elementary and Secondary; E = Elementary

A number of nurses suggested that complexity could not be rated without knowing the nurse's background. Thus, the returns for complexity were not used.

Mean percentages of time spent and recommended to be spent were calculated for each category. Actual and recommended time estimates seemed to give a more complete analysis of the work of a nurse functioning in the school. Table 3 shows the mean percentage of time spent and recommended to be spent in performing the major categories of functions for nurses serving the schools and employed by organizations other than boards of education in three population groups. The number of hours per week that a school nurse spent on the job was not averaged in this table. A large number of nurses in this group felt that they were unable to estimate the time spent in the school or they recorded the time spent in performing their generalized nursing program.

Table 4 shows the mean percentage of time spent and recommended to be spent in performing the major categories of functions for nurses serving the

schools and employed by boards of education for four population groups. The average number of hours per week that a nurse spent on the job was included.

The mean percentage of time spent and recommended to be spent as recorded in Tables 3 and 4 does not always total 100 percent but neither did some of the returns. In spite of this fact, the writer realized that time was estimated and that relationship was shown.

Problem areas that were thought to affect the execution of the functions were arranged in rank order according to the highest number of checks made by nurses serving the school and employed by organizations other than boards of education. The rank order and the number of nurses checking each problem area were as follows:

Rank Order	*Number of Nurses*
1. Need for more school nurses	183
2. Need for over-all school health planning	173
3. Lack of physical facilities	123
4. Inadequate budget	101
5. Lack of adequate relations with local dental and medical societies	101
6. Lack of community resources	89
7. Inadequate co-operation between the department of public health and board of education	65
8. Lack of proper relations with the school administrator	62
9. Inadequate job description	55
10. Inadequate follow-up program	35
11. Lack of equipment and supplies	35
12. Lack of supervision	28
13. No cumulative records	27
14. Lack of proper relations with parents	25
15. Lack of proper staff relations	22

The rank order of problem areas for nurses hired by boards of education was as follows:

Rank Order	*Number of Nurses*
1. Need for more school nurses	97
2. Need for over-all school health planning	69
3. Lack of community resources	56
4. Lack of physical facilities	52
5. Inadequate budget	40
6. Lack of adequate relations with local dental and medical societies	39
7. Inadequate job description	36
8. Inadequate co-operation between the department of public health and board of education	29
9. Inadequate follow-up program	25
10. Lack of equipment and supplies	15
11. Lack of supervision	15
12. Lack of proper relations with parents	12
13. Lack of proper staff relations	12
14. No cumulative records	11
15. Lack of proper relations with the school administrator	6

Additional factors thought to affect the performance of the functions were grouped under recommended educational courses, experiences, and skills. These were presented according to the number of respondents who made the suggestions and were as follows:

Recommended Additions to Education Course, Experience, and Skills	*Number of Respondents*
Degrees, programs, and certificates	29
Teacher educational courses and experiences	88
Exceptional child courses and experiences	9
Guidance and counseling courses and experiences	39
Hearing courses and experiences	8
Psychological courses and experiences	29
Public health courses and experiences	64
School nursing and health courses and experiences	66
Sociology courses and experiences	6
Visual courses and experiences	9
Workshops, institutes, inservice programs, and conferences	33

Analysis and Interpretation of Data

The wide variety of functions performed by the nurse was evidenced by the fact that one or more nurses performed each of the 132 items in the rating scale and that no item was performed by 100 percent of the nurses. However, two-thirds or more of the nurses performed 59 (44%) of the items and one-half or more of the nurses performed 76 (57%) of the items. This indicates that there is a similarity in the wide variety of functions performed and that more nurses are needed to execute additional functions. Therefore, a more comprehensive general nursing education program seems to be necessary for a nurse functioning in the school health program.

Even though consistency was noted in the wide variety of functions performed, failure to see the total problem as it exists was noted in a number of cases. For example, many nurses gave visual acuity tests and thought that this was an important function (percentage rank: frequency, 75 to 90 percent; importance, 36 to 95 percent) but did not state that it was very important to help evaluate heating, lighting, and ventilation in the school (percentage rank: frequency, 36 to 73 percent; importance, 15 to 35 percent). It seems illogical to give acuity tests and fail to see the importance of helping evaluate the lighting in the school.

Tables 1 through 10 in the author's doctoral dissertation show that more activities are performed by nurses employed by boards of education. These nurses devote their working hours to serving the school whereas a nurse employed by other organizations usually spends only part time in school activities. Hence, time devoted per week to school nursing seemed to play a part in the number of items performed by the nurses.

The rank order of the categories showing the number of nurses performing items in all groups studied is as follows:

Employed by Board of Education	*Employed by Other Organizations*
1. Follow-Up	1. Follow-Up
2. Emergency	2. Day-by-Day
3. Day-by-Day	3. Community Relations
4. Recording and Reporting	4. Emergency
5. Policy and Planning	5. Inservice and Professional
6. Inservice and Professional	6. Recording and Reporting
7. Community Relations	7. Policy and Planning
8. Instructional	8. Instructional
9. Medical Examination	9. Medical Examination
10. Healthful School Living	10. Healthful School Living

The ranking of categories is the same in items 1, 8, 9, and 10 above. The other categories seem to be listed as would be expected by the type of program which the nurse performs (generalized—part-time in the school; specialized—full-time in the school). For example, community relations rank much higher in the generalized program whereas emergency care is rated higher by the specialized nurse. The indications are that frequency of performance of the categories varies according to the time spent in the school.

The categories dealing with Follow-Up, Day-by-Day, and Recording and Reporting functions seem to be time consuming. This would indicate that more efficient methods should be employed and that the additional time gained should be used as recommended by the nurses in performing more Follow-Up and other necessary functions.

By the expression of a desire for more courses in education, public health, school nursing, and health guidance and counseling, and experiences in each field, it seems evident that the nurse feels a need for a broader educational background. Since the Follow-Up category of school health service ranks highest in performance and involves dealing with the child and the family, the home and the community, a broader educational background again is indicated. An analysis in each school of the problems related to health would assist in identifying the specific phase of nursing content required in preparation of nurses in the school health program.

Field experience in official agencies and school nursing is interrelated with the problem areas. A number of the problems point toward the co-ordination of the school and community health programs. Indications are that there is a need for experience in public relations and co-ordinated planning.

This study is not intended to represent a blueprint of what should be done in the schools but the material should help in defining the role of the nurse. It should be used as a basis for evaluating the various functions of the nurse in terms of education preparation, problem areas, and time consumption. The study should help establish policies but only as the results of administrators, teachers, nurses, physicians, and other pertinent groups discussing together the possibilities and values of such procedures.

Conclusions

From the analysis of data in this study the following conclusions were drawn:

1. Nurses functioning in the school health program perform a wide variety of activities.

2. A larger number of functions are performed and considered of utmost importance by nurses employed by boards of education than by other organizations.

3. The greatest agreement of the number of nurses performing items in all groups is within the Follow-Up category. The smallest agreement is within the Healthful School Living category.

4. There is a need for more nurses to function in the school health program and additional over-all planning of this program.

5. A broader educational background and experience are needed to prepare the nurse to function in the school health program.

6. Frequency in itself is not an adequate criterion when related to nurses in the school health program. It becomes valuable when used as a basis for evaluation and discussion.

References

1. Bland, Hester Beth. *An Analysis of Activities of Indiana Public School Nurses Employed by Boards of Education.* Doctor's thesis. Bloomington: Indiana University, 1956.
2. Fricke, Irma B., *chairman.* "Recommended Policies and Practices for School Nursing." *Journal of School Health* 27: 3-11; January 1957.
3. Grossman, Jerome. *The Nurse's Perception of Problems and Responsibilities; Implications for Professional Education.* Doctor's thesis. Berkeley: University of California.
4. National Conference for Cooperation in Health Education. *The School Administrator, Physician, and Nurse in the School Health Program.* School Health Monograph Number 13. New York: Metropolitan Life Insurance Co., 1946.
5. National Education Association and American Medical Association Joint Committee on Health Problems in Education. *The Nurse in the School.* Washington, D. C.: National Education Association, 1955.
6. Rappaport, Mary B. "Cooperation of the Nurse and Teacher in the Health Program in Small Communities." *Journal of School Health* 27: 48-52; February 1957.
7. Swanson, Marie. *School Nursing in the Community Program.* New York: Macmillan Co., 1953.

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Status of Physique, Change in Physique, and Speed in the Growth Patterns of School Children, Grades 1-8

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Abstract

Growth curves were plotted on the Wetzel Grid for 502 cases collected over a five-year period. Analysis of growth was made in terms of deviation from established standards of growth. Of the three factors studied, change in physique was the most variable. Physique showed a definite tendency to be more variable as grade level increased. Girls were more variable in all factors than were boys. Grade level showed little relationship to changes in physique and speed. Physique apparently reflects changes in growth patterns in both speed and changes in physique, and speed of growth has a tendency to reflect changes in physique.

THE CHARACTER OF GROWTH demands intensive study in a society which stresses the individuality of each child. Health and physical educators, by virtue of their proximity to environmental conditions which greatly affect growth, should be particularly interested in this important area of total development.

Much research has been completed inquiring into the nature of various aspects of physical growth. The Harvard studies (5), Iowa studies (7), California studies (1), University of Chicago studies (11), and Brush Foundation studies (15) have all contributed considerably to an increased knowledge of growth.

Many studies have delved into the nature of physique. Most of these studies have attempted to categorize individuals on the basis of specific criteria which have their origin in the physical or organic make-up of man. Cozens (4) and McCloy (6) have recommended height-weight and height-weight-age combinations as means of classifying students for physical education activities, thereby inferring that some measure of physique is important in physical education. Sheldon (12), in an exhaustive study of the nature of physique, isolated 76 somatotypes which are identifiable by use of hundreds of physical criteria. Wetzel (16), using measurements of height and weight, and Meredith (8), using measurements of height, weight, and age, have proposed systems of securing the physique of an individual through the use of growth charts.

Several studies have attempted to determine the relationship that exists between physique and various physical education measures. Among college women Perbix (9) found a definite relationship between mesomorphy and strength and power, and endomorphy with strength and power inversely.

Bookwalter and others (2) reported significant relationships between body shape and size and certain measures of physical performance. Winthrop (18) studied the consistency of attitude patterns in relation to body type. Sills and Everett (13) concluded that body type has a definite relationship to measures of agility, speed, and endurance. Willgoose and Rogers (17) reported that mesomorph-ectomorphy as a physique group scored highest on a selected physical fitness test and that endomorphs apparently are limited in physical fitness by their physiques. Sills and Mitchem (14) established norms in physical fitness test scores on the basis of somatotyping.

Statement of the Problem

This study was made to further analyze selected factors in physical growth in a manner that would enable the teacher to understand better the role played by these factors in the growth of children. The purpose was to determine the status of physique, change in physique, and speed in growth patterns of children in a typical elementary school (grades 1-8) and to investigate further the relationships that existed between these factors of growth as shown in the patterns of the children studied. The factor of physique was further studied in terms of stockiness or thinness. Change in physique was investigated from the standpoint of change toward obesity or change toward thinness. Speed of growth was studied from the standpoint of acceleration or retardedness.

The answers to several basic questions were sought in this study. What were the proportions of students who deviated excessively in physique, in change of physique, and in speed? What proportion of students who deviated excessively in one of these factors also deviated excessively in one or more of the others? Were there significant relationships between the factors of physique, change in physique, and speed in the growth patterns of the children studied? What influences in the growth patterns could be attributed to sex or to grade level?

Definition of Terms

Growth—increase in body mass.

Physique—the body build or shape of the student.

Stocky—the body build of students with less height per standard weight or more weight per standard height than the medium or "average."

Obesity—extreme stockiness.

Thinness—the body build of students with more height per standard weight or less weight per standard height than the medium or "average."

Change in direction—the varying of body shape from one measuring period to another.

Change toward obesity—the varying of body shape from one measuring period to another as a result of increasing weight too rapidly in proportion to increasing height.

Change toward thinness—the varying of body shape from one measuring period to another as a result of increasing height too rapidly in proportion to increasing weight.

Speed of growth—the degree to which a student maintained progress in growth in comparison with his predetermined tendency to grow.

Accelerated growth—accumulation of excessive height, weight, or height and weight which projects the actual growth curve to a more advanced level than would be expected from previous tendencies to grow.

Retarded growth—accumulation of debits in height, weight, or height and weight which causes the actual growth curve to fall behind the level that would be expected from previous tendencies to grow.

Deviate in growth—the student who exceeded the limits of standards established for this study.

Procedures Followed

Measurement of Growth Factors. The Wetzel Grid was used in measuring the growth factors in this study. It has been termed a reliable instrument, is reasonably objective, and is fairly simple to use (3).

Specific directions for the use of the Grid may be found elsewhere (16). In general, physique is measured in terms of nine oblique channels running diagonally from the lower left corner to the upper right corner of the Grid panel. The height and the weight of a given individual, when properly plotted, designate a single point in one of the channels of the system. This channel indicates the physique of the individual at the time of measurement.

A healthy child will show a growth pattern leading in a more or less direct manner up the selected channel, with little, if any, crossing over from one channel to another (3). Since each of these channels indicates a particular physique or body type, any crossing over from one channel to another indicates a change of physique. It should be pointed out that neither physique nor change in physique requires comparison of the growth of a particular student with the growth of other students in order for these factors to be evaluated.

Evaluation of speed of growth requires a comparison of the growth curve of an individual with a "normal" growth curve of other individuals of like chronological age, sex, and size. According to standards of the Grid, once a child has established his relative position in terms of size among children his own age and sex, he should grow at a rate of speed compatible with this mass of children with like characteristics (16). The quality of growth in terms of speed is determined by comparing the actual growth record of the student with this "normal" growth curve. Such a comparison is made possible through use of the auxodrome panel of the Wetzel Grid.

With one exception, the standards used in this study to evaluate the quality of growth were those recommended by Wetzel. These standards enable users of the Grid to screen those students failing to grow satisfactorily so that more intense diagnosis may be made of possible causes for such failure. Each of the factors of growth under study are characterized by a middle "normal" range exceeded in both directions by extremes. Since the standards in this study fall at the outside borders of this normal range, the proportion of students who were normal and who deviated from normal in either direction indicated the variability in the factor studied.

The standards, indicating how excessive deviation of each growth factor was determined, were as follows:

Physique—Deviation from the middle five channels of the Grid panel (A_2 — B_2) was considered excessive. Those who indicated points on the panel to the left of these five

channels (A_3 and beyond) were considered excessive deviates because of stockiness.[1] Those whose points on the panel were to the right of the middle five channels (B_3 and beyond) were considered deviates because of thinness.

Change in Physique—Deviation of more than one-half channel per ten levels of development was termed an excessive shift in physique. Subjects who changed in the direction of channel A_8 were considered deviates toward obesity. Pupils who changed in the direction of B_8 were considered deviates toward thinness.

Speed—Deviation of more than three levels of development from the student's own projected growth curve in a 12-month period caused him to be classified as a deviate in speed. If he failed to grow rapidly enough to keep up with his projected growth curve or auxodrome, he was classified as a deviate due to retardation. If he grew too rapidly, surpassing his projected growth curve, he was classified as a deviate because of acceleration.

Pugh (10) has found the Grid much too selective, causing many children that were later found to be healthy to be referred for medical examinations. However, these standards afford a simple means of classifying students so the degree of divergence from "normal" or "average" can be studied. It would perhaps be wise for the reader to think of deviates in this study as extremes in growth in the factor studied.

Collection of Data. The Wetzel Grid was introduced as a diagnostic instrument in the first four grades of the Campus School, Wisconsin State College at River Falls, in January 1953. Each subsequent year the new first grade was added and all previous groups were retained for study. By the end of five years all grades (1-8) were under observation. This procedure combines the basic features of longitudinal and cross-sectional types of studies. As a result of these procedures the number of students observed in the upper grades was considerably smaller than that of the lower grades. Table 1 shows the distribution of cases by grade level and sex.

Measurements of height and weight were made within one week of January 15 each year. Therefore, progress of growth as studied is that over one-year periods ranging from January to January. Children were measured in street clothes with coats, hats, sweaters, jackets, and shoes removed. The same measuring devices were used throughout the study. All ages were secured from school records.

After each measurement period, growth curves were plotted on the Grid. Each growth curve was then evaluated for the specific factors under study and was categorized according to grade level and sex. The data collected in this study resulted from application of the selected standards of growth to these curves. The final number of growth curves studied ranged from 363 to 502, depending on the factor involved. Since analysis of physique required only one measurement, the number of curves available for study of this factor was considerably larger than that for the other two factors studied.

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[1] This standard was added to those of Wetzel in order to better indicate the variability of the students studied in physique. A_3 is considered stocky and A_4 obese by Wetzel.

TABLE 1.—NUMBER OF STUDENTS STUDIED IN EACH CATEGORY

Factor of Growth	Boys				Girls				All Students			
	Grades				Grades				Grades			
	1-3	4-6	7-8	Total	1-3	4-6	7-8	Total	1-3	4-6	7-8	Total
Physique	111	115	24	250	111	111	30	252	222	226	54	502
Change in physique	57	99	23	179	62	92	30	184	119	191	53	363
Speed	57	99	23	179	62	92	30	184	119	191	53	363

TABLE 2.—SIGNIFICANCE OF RELATIONSHIPS BETWEEN PHYSIQUE, CHANGE IN PHYSIQUE, SPEED, SEX, AND GRADE LEVEL

Factor of Growth	Physique				Change in Physique				Speed			
	N	Degrees of Freedom	χ^2	Level of Significance	N	Degrees of Freedom	χ^2	Level of Significance	N	Degrees of Freedom	χ^2	Level of Significance
Change in physique	363	4	13.14	2%								
Speed	363	4	20.84	1%	363	4	77.93	1%				
Sex	502	2	16.76	1%	363	2	2.81	25%	363	2	14.66	1%
Grade level	502	4	25.87	1%	363	4	1.89	80%	363	4	7.10	18%

Analysis of Data

Growth curves in this study were analyzed from three separate points of view. First, the proportion of students who failed to meet the established standards in each of the factors was determined. Second, the significance of the relationship between the growth factors under study was found. Third, students who failed in a given factor of growth were further analyzed for the proportion that also failed in one of the other factors, thereby offering some evidence of the relationship that exists between the two causes of failure.

PROPORTION OF DEVIATES IN EACH FACTOR

Physique. Of the elementary school children studied, 14 percent were classified as excessive deviates because of physique. Nine percent of these failures were because of stockiness, 5 percent because of thinness. Girls (17%) failed in physique more than boys (10%). Practically all of this difference can be accounted for in the proportion of deviates due to thinness. The boys had a very small proportion of failures in this factor, while the girls showed failure at the rate of 9 percent.

A very definite trend toward increased variability in physique as the grade level increased was observed. This trend is graphically shown in Figure I. In grades 1-3 only 5 percent of the subjects studied deviated from the middle five channels in physique. In the middle grades (4-6) this percentage increased to 19. Grades 7-8 showed deviation at the rate of 28 percent. About the same trend was shown for obesity, with each subsequent grade level showing increasingly higher proportions of deviates from this cause.

Practically all deviates in physique among boys in the entire study could be attributed to excessive stockiness. No such tendency was observed for girls. The proportion of deviates among girls was fairly evenly divided between those too stocky and those too thin.

Change in Physique. Forty-seven percent of the students studied for one year or more showed changes in physique beyond the standard accepted for use in this study. Of the boys, 42 percent were excessive deviates; of the girls, 51 percent exceeded the standard. Grade level apparently had little significance, although the lower grades showed slightly fewer failures among both boys and girls. Boys showed greatest change in physique at grades 4-6, while girls increased slightly in the proportion of deviates as the grade level increased. There appeared to be no difference between the proportions of students who deviated toward obesity and the proportions of those who deviated toward thinness. The proportions were very nearly 50-50 for all grade levels and for both sexes.

Speed. Of the total number of students studied, 37 percent failed to grow at a rate of speed that caused their growth curves to remain within the limits established for speed of growth. Girls accounted for 61 percent of these failures. Since both groups showed approximately the same proportion of deviates because of slow or retarded schedules of growth, the most important difference between the sexes in terms of speed of growth was in acceleration.

There appeared to be a tendency for students to show greater deviation by growing too fast, particularly among girls, in the early grades. This tendency was reversed in the upper grades, with retardation causing the greater failure. This was particularly true among the boys. In the middle grades (4-6) acceleration and retardation showed about the same proportion of failures for both boys and girls.

Of the three factors of growth studied, change in physique contributed the highest proportion of excessive deviates, speed the next highest proportion, and physique the smallest proportion. Girls appeared to be more variable in growth as measured than boys. The variability in body shape or physique

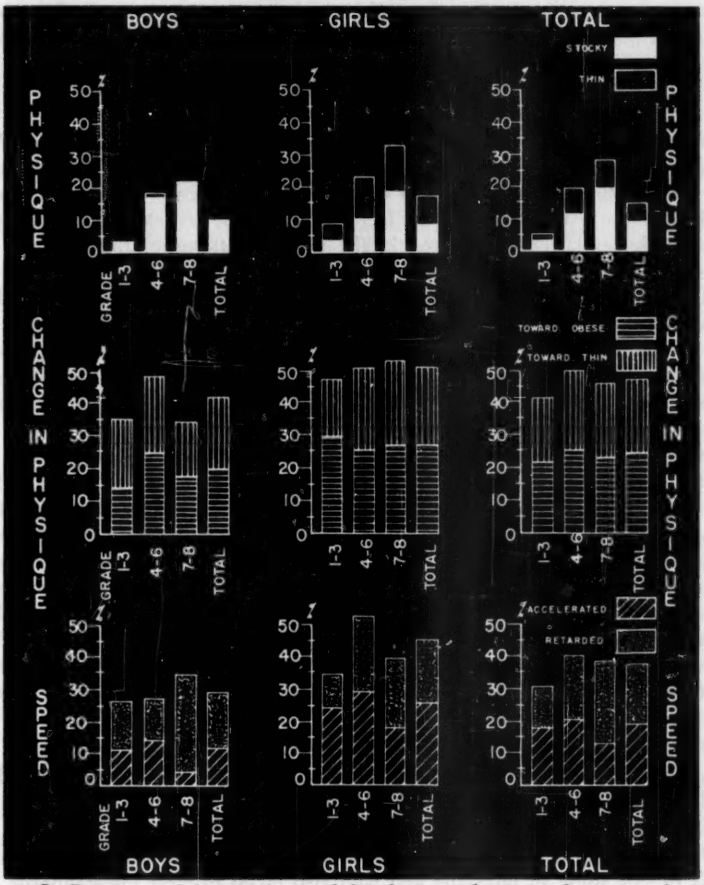

Figure I. Proportion of deviates in growth by physique, change in physique, and speed.

of both boys and girls increased as grade level increased. Larger proportions of students were found at the extremes as grade level increased. Boys showed considerably more deviation in stockiness than in thinness.

In speed, girls were more variable than boys, particularly by growing too fast. There was a tendency for more students to be accelerated in the lower grades and retarded in the upper grades among speed deviates.

SIGNIFICANCE OF RELATIONSHIP BETWEEN GROWTH FACTORS

The χ^2 test of independence was employed to determine the significance of relationships that existed among physique, change in physique, and speed, and among these factors and sex and grade level. This statistical technique was employed to test the hypothesis that the factors were unrelated. Rejection of the hypothesis pointed to significant relationships but did not necessarily give an indication of the degree of relationship present.

Table 2 shows the value of χ^2 which was found for each pair of growth factors and between each growth factor and sex or grade. The hypothesis of unrelatedness was rejected between physique and all factors studied. All relationships were significant at beyond the 1 percent level of confidence except that between physique and change in physique, which was signficant at beyond the 2 percent level. The factors of physique and change in physique and grade level were all related in the growth patterns of the children in this study.

Change of physique and speed of growth also showed a significant relationship. The hypothesis that these factors were unrelated was rejected at far beyond the 1 percent level of confidence. Neither sex nor grade level was significantly related to changes in physique. The relationship between speed and sex was statistically significant (1 percent level of confidence), while speed and grade level appeared to be nonrelated.

COMBINED FAILURES IN GROWTH FACTORS

Since at least two successive measurements were necessary to evaluate the success of growth in terms of changes in physique and speed of growth, those deviates in physique determined from single measurements were eliminated from this phase of the study. Physique deviates were subdivided into two groups—those who were excessively stocky and those who were excessively thin. Change in physique deviates were subdivided into those who changed in the last year excessively toward increased obesity and those who changed in the last year excessively toward increased thinness. Speed deviates were studied in two groups—those who were growing too fast and those who were growing too slowly.

With Deviation in Physique. The number of cases showing failure in physique was relatively small. This limitation should be considered in the following interpretations concerning combinations of other types of failure with that of physique.

Figure II shows the percentages of students who failed to meet the standards of this study in physique and who also failed to meet the standards in

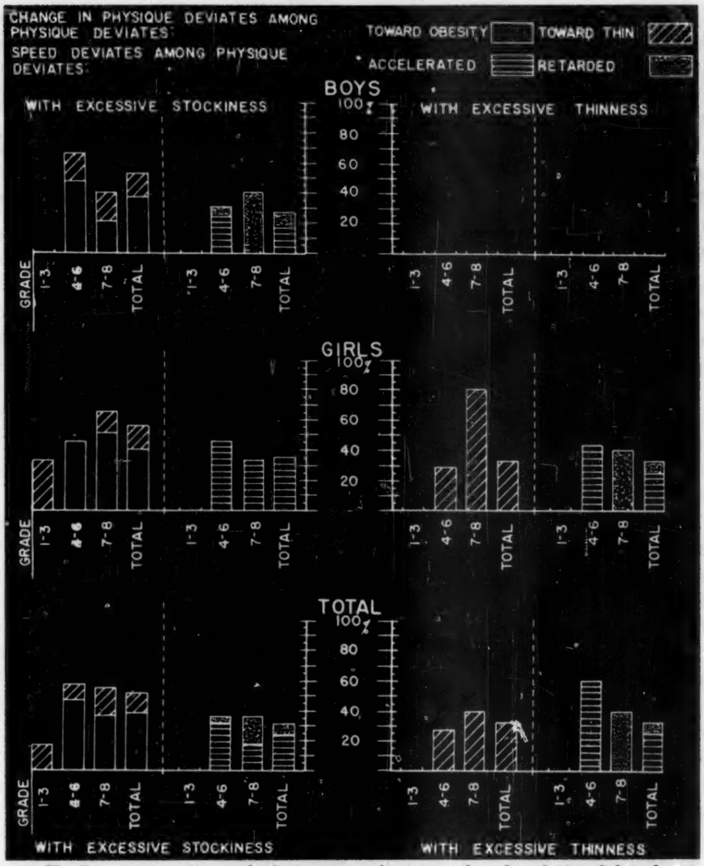

FIGURE II. Proportion of growth deviates in physique who also deviated by change of physique and speed.

one of the other factors of growth under study. Fifty-two percent of the boys who were excessively stocky also showed excessive changes in physique. Sixty-nine percent of them were showing tendencies toward more pronounced stockiness or obesity, while 31 percent were moving toward a more "medium" body build. Twenty-eight percent of the excessively stocky were also excessive deviates in speed, with the proportion showing accelerated growth being approximately equal to that showing retarded growth. Boys showed few deviates in physique because of excessive thinness, and none of these were growth failures in any of the other factors studied.

Approximately one-half of the girls who were extremes in physique because

of excessive stockiness also made changes in physique that were too drastic. Also like the boys, approximately 70 percent of this group were changing physique in the direction of obesity, while approximately 30 percent were moving toward a "medium" body build. Thirty-five percent of the girls who were too stocky also deviated in speed, all growing too fast.

Unlike the boys, 33 percent of the girls who were excessively thin also changed in physique too rapidly, with all of them changing to a still more extremely thin body build. One-third of the excessively thin girls also were failures in speed. Oddly enough, 76 percent of them were accelerated in growth, while 24 percent were retarded.

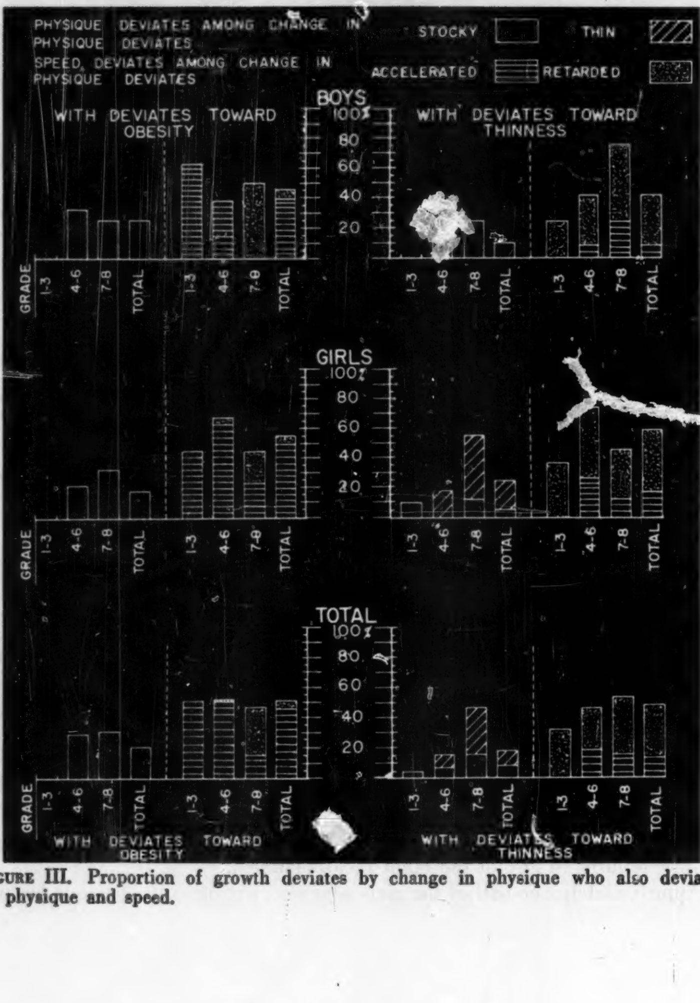

FIGURE III. Proportion of growth deviates by change in physique who also deviated by physique and speed.

With the exception of grades 1-3, where the number of cases was very small, the proportion of students showing extreme speed and change of direction among students showing extreme types of physique remained somewhat constant at all grade levels. There appeared to be a very definite trend for extremes in physique who were making changes in physique to move toward greater extremeness, the stocky toward increased stockiness and the thin toward increased thinness. This fact, coupled with the trend toward increased proportions of failures in physique as grade level increased, points to a very definite conclusion regarding the nature of physique in elementary school children.

With Deviation Due to Change in Physique. Figure III shows the proportion of students who showed excessive shifts in physique and who failed to meet the standards of the other growth factors studied. Twenty-four percent of the total number of students studied showed excessive shifts in body type in the direction of obesity.

Among these deviates 20 percent showed extremeness in physique, all because of excessive stockiness. Fifty-one percent were growth failures because of speed, with 88 percent of them growing too rapidly. The proportions for boys and girls were approximately the same for these relationships. Grade level apparently had little significance in these proportions.

Twenty-three percent of the total number of students studied made excessive changes in physique toward thinness. About one-fifth of this group were also extremes in physique, with slightly more than one-half of them so classified because of extreme thinness. Approximately 50 percent also deviated in speed, 13 percent growing too fast and 37 percent growing too slowly.

Sex apparently had some influence in the relationship that existed between shift in physique toward thinness and the other factors studied. Boys showed 10 percent failures in physique among this group, all because of excessive stockiness. Girls showed 23 percent physique failures, 5 percent being overly stocky and 18 percent being too thin. The proportions of boys and girls in this group showing speed failure were approximately the same, with one-fourth failing because of growth acceleration, the remainder because of growth retardation.

With Deviation Due to Speed. The proportion of physique and change in physique deviates among deviates in speed is shown in Figure IV. Among the students classified as speed deviates because of accelerated growth, 16 percent were also deviates in physique with all of them showing excessive stockiness. The proportions for boys and girls were approximately equal.

Seventy-one percent of the speed deviates because of accelerated growth also changed physique excessively, approximately three-fourths of them shifting toward obesity. Boys showed a tendency for more deviates shifting toward stockiness, particularly in the early grades.

Seventeen percent of those students who were retarded in growth showed extremes in physique, 5 percent of them because of excessive stockiness and 12 percent of them because of extreme thinness. Boys and girls differed

somewhat in the proportions of failures due to stockiness or thinness in this group. Boys showed a tendency toward failures due to stockiness, girls deviated largely because of thinness.

Fifty-five percent of the students who were retarded in growth also changed physique excessively, 3 percent toward obesity and 47 percent toward thinness. Boys and girls showed approximately the same tendencies in this group.

Summary and Conclusions

The growth curves of children, plotted over a five-year period, were analyzed for the status and relationships of physique, change in physique,

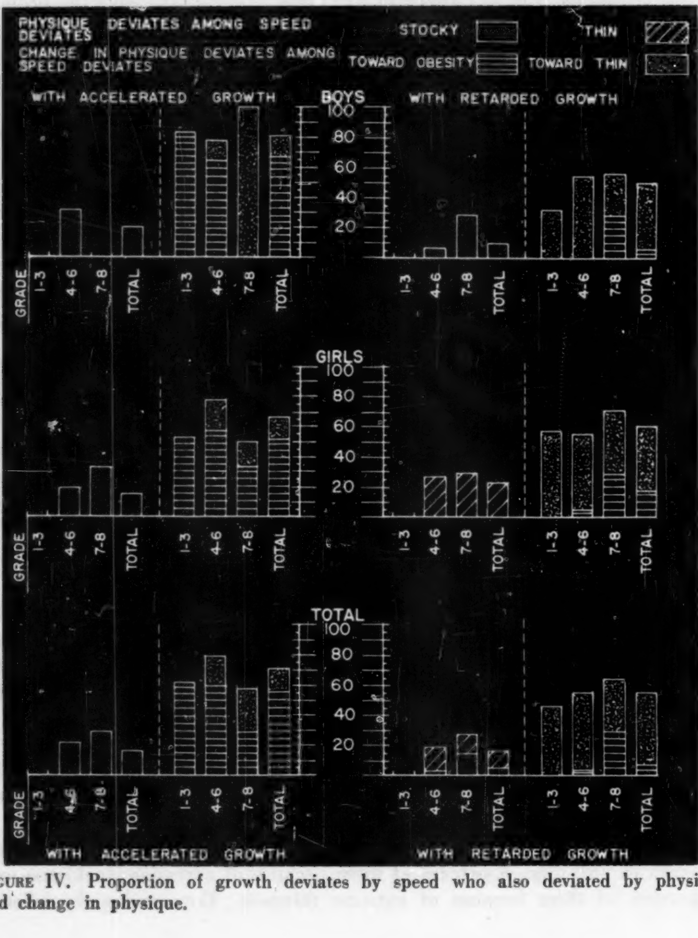

FIGURE IV. Proportion of growth deviates by speed who also deviated by physique and change in physique.

and speed. The Wetzel Grid was used in studying these factors. The following conclusions were reached as a result of this study.

1. Of the three factors in growth investigated, change in physique was the factor to which the greatest proportion of failures could be attributed (47 percent of all curves studied). Speed of growth showed 37 percent failures and physique only 14 percent.

2. The proportion of students with extreme physiques, particularly in the stocky or obese category, increased significantly as grade level increased.

3. Grade level had little influence on the proportions of students who showed excessive changes in physique or who grew too fast or too slowly.

4. Girls showed an inclination to grow too fast in the early elementary grades, while boys tended to be retarded in growth in greater proportions in the upper grades.

5. Girls were significantly thinner than boys in this study.

6. Of the students who were considered extremes in physique, about half showed shifts in physique from the preceding measurement. There was a strong tendency for them to move toward increased obesity or thinness.

7. Approximately half of the students who were excessive deviates because of change in physique moved in the direction of obesity, half in the direction of thinness. There was a definite trend for those moving toward obesity to grow too fast, and not quite as positive a trend for those moving toward thinness to grow too slowly.

Physique apparently is a composite that reflects changes in physique and speed of growth accumulated in periods previous to measurement. Speed of growth is a characteristic which, when measured as in this study, reflects direction shifts or changes in physique over a prolonged period of time. Change of physique, by definition, were limited to those observed in a one-year period preceding measurement. The first indication of trends toward extreme stockiness or thinness is seen in changes in physique. A second and more serious indicator of potential extremeness in physique is in accelerated or retarded growth patterns. Both factors afford the opportunity to correct the trend toward extreme physique before such extremeness becomes an actuality. However, the wise parent, teacher, or counselor will be aware of the high proportion of students who correct tendencies toward extremes in growth patterns without apparent help.

References

1. Bayley, Nancy. "Child Development—V. Physical Growth." *Encyclopedia of Educational Research.* Revised edition. (Edited by Walter S. Monroe.) New York: The Macmillan Co., 1950. p. 153-56.
2. Bookwalter, Karl W., and others. "Relationship of Body Size and Shape to Physical Performance." *Research Quarterly* 23: 271-79; October 1952.
3. Breckenridge, Marian E., and Vincent, E. Lee. *Child Development.* Third edition. Philadelphia: W. B. Saunders Co., 1955.
4. Cozens, Frederick W. "A Study of Stature in Relation to Physical Performance." *Research Quarterly* 1: 38-45; March 1930.

5. DEARBORN, W. F., and RATHNEY, J. W. M. *Predicting the Child's Development.* Cambridge, Massachusetts: Science-Art Publishers, 1941.
6. MCCLOY, CHARLES H. *Tests and Measurements in Health and Physical Education.* Second edition. New York: F. S. Crofts and Co., 1947.
7. MEREDITH, H. V. *The Rhythm of Physical Growth.* Studies in Child Welfare, Vol. 11, No. 3. Iowa City: University of Iowa, 1935.
8. MEREDITH, H. V. *Physical Growth Record.* NEA, Washington, D. C.: Joint Committee on Health Problems in Education, NEA and AMA, 1947.
9. PERBIX, J. A. "Relationship Between Somatotype and Motor Fitness in Women." *Research Quarterly* 25: 84-90; March 1954.
10. PUGH, MOLLY C. "Charting Growth with the Wetzel Grid." *Journal of Health-Physical Education-Recreation* 25: 47-49; March 1954.
11. RICHEY, H. G. "The Relation of Accelerated, Normal, and Retarded Puberty to the Height and Weight of School Children." *Society for Research in Child Development Monograms,* Vol. 2, No. 1; 1937.
12. SHELDON, W. H., STEVENS, S. S., and TUCKER, W. B. *The Varieties of Human Physique.* Second edition. New York: Harper & Brothers, 1940.
13. SILLS, FRANK D., and EVERETT, P. W. "Relationship of Extreme Somatotypes to Performance in Motor and Strength Tests." *Research Quarterly* 24: 223-28; May 1953.
14. SILLS, FRANK D., and MITCHEM, J. C. "Prediction of Performances on Physical Fitness Tests by Means of Somatotype Ratings." *Research Quarterly* 28: 64-71; March 1957.
15. SIMMONS, KATHERINE. "The Brush Foundation Study of Child Growth and Development: II, Physical Growth and Development." *Society for Research in Child Development Monograms,* Vol. 9, No. 1; 1944.
16. WETZEL, NORMAN C. *The Treatment of Growth Failure in Children.* NEA Service, Inc., 1948.
17. WILLCOOSE, CARL E., and ROGERS, MILLARD L. "Relationship of Somatotype to Physical Fitness." *Journal of Educational Research* 42: 709-10; 1949.
18. WINTHROP, H. "Consistency of Attitude Patterns as a Function of Body Types." *Journal of Personality* 25: 372-82; March 1957.

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Effects of Various Training Programs on Speed of Swimming

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Abstract

Six groups of subjects were tested to determine if various training programs affected performance in speed in swimming 30 yards. No evidence of improvement was found after one group of subjects had been exposed to absolutely no exercise for six weeks and, also, after a group of subjects had participated in various exercises with weights three times weekly for six weeks. Two groups of swimmers who participated in practicing starts, kicking, arm stroking, and sprinting 30 and 60 yards significantly improved their performances in speed in swimming; one group of subjects followed the preceding program three times weekly and another group used the same routine six times a week. Two other groups, one of which was exposed to weight training and swimming, and one of which was exposed only to 30-yard sprints and practicing starts, both showed statistically significant differences in performance.

AVAILABLE RESEARCH related to training programs for swimmers is very limited. Except for opinions based upon empirical observations, little is known regarding the effects of various training programs on speed in swimming.

Davis (3) attempted to determine the effect of a vigorous and comprehensive weight training program upon speed in swimming the crawl stroke. His findings revealed that after the weight-training period all 17 subjects increased their speed in swimming the crawl stroke. He concluded that his information would seem to indicate that weight training is not detrimental to swimming, but highly beneficial.

Although the writers could not locate any other scientific studies regarding the effects of weight training on speed of swimming, there are studies which show the effects of weight training on other muscular movements. Zorbas and Karpovich (7) attempted to determine the effect of weight lifting on the speed of muscular contractions. They reported that the weight lifting group was faster in rotary arm movements than the nonlifters. Wilkin (6) reported that weight training, over a period of one semester, had no effect on speed of arm movement. He stated that the chronic weight lifter was not "muscle-bound" in the sense that his speed of movement was impaired. The weight lifter's speed of movement was as great as that of other students studied and seemed to improve as much or more during a semester of training. Hairabedian (4) reported that weight training was associated with a significant increase in strength of subjects over a six-week period and that this increased strength appeared to be related to a significant increase in speed of movement. Tominaga (5) attempted to determine the effect of a six-week weight training

program on the speed of pitching a baseball. He concluded that weight training did not have a significantly deleterious effect upon the speed at which baseballs could be pitched. Capen (1) reported that weight training, at least when limited to the extent to which it was in his experiment, did not result in muscular tightness and did not produce a decrease in speed of muscular contraction.

Chui (2) studied the effect of systematic weight training on athletic power. He reported that his subjects, after completing the program in weight training, seemed to have increased power. He stated that power is apparently limited by muscular viscosity and that, with greater speed of contraction, more is required to overcome the viscosity of the muscles. With an increase in strength, however, Chui assumed that more force is available to overcome the viscosity of the muscle and to force the velocity to higher levels.

In view of the evident lack of scientific evidence regarding the effect of weight training on speed of swimming, the writers decided to undertake the present study. It was also felt that it would be of interest and value to compare the effects of other types of training programs on the speed of swimming.

Procedure

The subjects of this experiment were 81 male students between the ages of 17 and 26, all students at Pennsylvania State University. Before they were permitted to serve as subjects, they were rated, along with other students, on their ability to perform the American crawl stroke—the leg kick, arm stroke, rhythmic breathing, and combined stroke. Ratings were based on the following four point scale: 4—Good; 3—Average; 2—Below Average; 1—Poor. The students were rated by three qualified Red Cross instructors. Eighty-one subjects were retained for experimental purposes because of their four point ratings on the crawl stroke.

All swimming was done in the Glennland swimming pool, which measured 90 ft. by 45 ft. The average air temperature within the pool area during the course of the study was 82° F. The average water temperature throughout the entire experiment was 86° F.

An introductory talk was given which outlined the procedures that would be employed in the study. All the subjects agreed to get eight hours of sleep nightly and not to drink any intoxicating beverages throughout the six weeks which had been set aside for the various training programs. As the subjects ate all their meals either in the dormitories or in the fraternity houses on campus, their diets could not be regulated. However, the meals furnished by both housing establishments were very nourishing and provided well-balanced diets. In addition to the above agreements, the students also agreed to follow their training programs vigorously and regularly.

After the introductory talk, the subjects showered and swam one width of the pool. They were then timed separately for the 30-yard sprint swim. Each subject was timed by an experienced timer with a stop watch calibrated in tenths of a second. The same timer was used throughout the testing process. In order to avoid making any turns, the swimmer swam one length of the 90-

foot pool using the American crawl stroke. The timer stood directly behind the swimmer when he started. The swimmer started at his discretion. As the swimmer's feet left the end of the pool, the timer started the stop watch. The timer then proceeded to trot to the opposite end of the pool and stood directly above the swimmer's lane. The watch was stopped when the swimmer first touched the end of the pool with either hand. These procedures were employed throughout the study whenever any timing was done.

Each subject was randomly assigned to one of the following six training programs before he was first timed: Control Group, Weight Training Group, Swimming Group I, Weight Training and Swimming Group, Swimming Group II, and Swimming Group III.

CONTROL GROUP: This group was comprised of 15 subjects who participated in absolutely no vigorous exercise throughout the entire six-week training period.

WEIGHT TRAINING GROUP: The weight training group was comprised of 15 subjects and met for three 40-minute periods each week. An increased resistance method was employed so that each time a subject was able to complete ten repetitions of a prescribed exercise, ten additional pounds were added to the weight for that exercise during the following weight training period. The subjects attempted, during each weight training session, to complete ten repetitions of each of the following exercises:

1. *Two-arm curl.* Using a reverse grip the subject lifted a loaded bar to approximately hip level with both arms fully extended. An erect standing posture was assumed after lifting the weight from the floor. The exercise was performed by flexing the arms and bringing the loaded bar to shoulder height and then lowering it to hip level.
2. *Two-arm press.* Employing a regular grip, a loaded bar was lifted to chest height by flexing the arms, and an erect standing posture was then assumed. The exercise was performed by extending the arms overhead until they were in a fully extended position, and then lowering to chest height.
3. *Deep-knee bend.* A loaded bar was placed on the shoulders with the bar resting on the back of the neck. The knees were flexed as far as possible until a deep squat position was assumed and were then extended to bring the subject to an erect standing position.
4. *Bench press.* The subject assumed a supine position on a padded bench. A loaded bar was supported above the chest by two vertical uprights. A regular grip was used, and the bar was lowered until it touched the chest lightly and was then raised by extending the arms fully.
5. *Dead lift.* The subject flexed the trunk and grasped the loaded bar with an overhand grip. The legs were kept fully extended throughout the performance of this exercise. By extending the trunk and keeping the arms fully extended, the loaded bar was raised from the floor until an erect position was assumed.
6. *Rowing.* In a standing position the body was flexed with the legs held in a fully extended position. A loaded bar was grasped with an overhand grip and raised upward toward the chest by rotating the arms outward at the shoulders, and by flexing the arms at the elbows.
7. *Leg press.* The subject assumed a supine position on a padded mat. By flexing his legs he placed his feet into two metal boots which were above him and attached to a loaded bar. The bar was supported above the hips on two vertical uprights. By extending the legs the weighted bar could be raised, and by flexing the legs it could be lowered to its original position.

8. *Latissimus dorsi exercise.* An apparatus was constructed which consisted of an inverted Y-shaped rod attached to a chain approximately six feet above the floor. The chain passed upward through an overhead pulley and then downward to where it was attached to weights which rested on the floor. The student stood facing the device, grasped the rod at each end of the inverted Y and pulled it so that it passed over the head and down behind the neck. Pulling the rod in this manner raised the weights from the floor.

9. *Rise on toes.* A loaded bar was placed on the shoulders with the bar resting on the back of the neck. The subject was in a standing position with legs spread at a distance of approximately shoulder width and toes pointed forward. Subject rose as high as possible on his toes and then lowered slowly to his original position.

10. *Pull-up to chin.* Using an overhand grip the subject lifted a loaded bar to approximately hip level with both arms fully extended. The bar was raised upward under the chin by rotating the arms outward at the shoulders, and by flexing the arms at the elbows.

Although the same progression method could not be used for all exercises, other exercises in addition to the ones listed above were performed during each weight training period. It will be necessary to list separately the progression method for each of the following exercises.

11. *Pullover.* The subject assumed a supine position on the floor with a 25-pound bar directly behind his head. He grasped the bar with an overhand grip and keeping the arms straight at all times slowly brought the bar from behind the head in a circular path to the thighs and back to the original position. When the subject satisfactorily completed ten repetitions of this exercise, the weight was increased in 5-pound intervals.

12. *Pull-up.* An overhead horizontal bar was grasped with a reverse grip (palms toward the subject) with the body in an elongated hang position. The arms were then flexed until the chin was above the level of the horizontal bar and were then extended so that the body was lowered to the starting position. The subject continued to perform pull-ups until fatigue precluded his continuing.

13. *Sit-up.* The subject lay supine on the floor with hands clasped behind his neck. He would sit up as far as possible, keeping his legs extended throughout the performance of the exercise. Upon completion of 20 repetitions on the floor, he then performed his sit-ups on a board with an incline of 15 deg. From there, the angle of the board was progressively raised to 30 and 45 deg. Once the subject completed 20 sit-ups on the board at an incline of 45 deg., a 10-pound weight was placed behind the subject's neck; he then began his sit-ups on the floor, and the same progression was again repeated.

14. *Push-up between benches.* With the feet on one bench and the hands on another, the subject flexed at the elbow and permitted his body to drop down between the hands. The subject then extended the elbow to push up, keeping the body straight at all times. The subject performed 20 repetitions of this exercise, and then weights were added in intervals of ten pounds.

SWIMMING GROUP I: This group was comprised of 13 subjects who swam the following routine three times weekly:

1. Flutter kick for 150 yards, using no arm stroke.
2. Arm pull for 150 yards, using no leg kick.
3. Two 60-yard sprints at three-quarters speed, using the American crawl only.
4. Three 30-yard sprints at full speed, using the American crawl only.
5. Practice ten starts.

WEIGHT TRAINING AND SWIMMING GROUP: This group was composed of 13 subjects. They swam three times weekly using the same routine as Swimming Group I and employed the same exercises as the Weight Training

Group three times weekly. This group swam one day and lifted weights the next with only one day off a week.

SWIMMING GROUP II: Ten subjects formed this group, which used the same routine as Swimming Group I, with the exception that they swam six times a week instead of three times a week.

SWIMMING GROUP III: Fifteen subjects comprised this group, which used the following routine six times weekly:

1. Twelve 30-yard sprints at full speed with rest periods of three minutes between each sprint.
2. Practice ten starts.

To ascertain whether or not the subjects reported for swimming practice, a lifeguard was provided with the names of the subjects and the routines that were prescribed for them. The swimmers had to report to the lifeguard at 4:15 p.m. on the days that they were to practice.

On the final day of the six-week period or the cessation of the training programs, all the subjects were again timed separately to see if any significant change in time had occurred.

Analysis of Data

The scores of the 81 speed swimmers were expressed in the number of seconds required to swim 30 yards. Inasmuch as there were less than 50 subjects in each training group, the t table was used to determine the 5 and 1 percent levels of confidence.

The mean time of the subjects in the Control Group was .28 sec. slower in the final time trials than the mean time in the initial testing. The difference between the means had a t ratio of 1.65. This t ratio indicated that there was not a statistically significant difference between the first and final performances in speed of swimming 30 yards; therefore; it would seem that since the subjects did not participate in any exercise, the group as a whole tended to swim slower.

Nine of the 15 speed swimmers swam from .1 to 2.4 sec. slower after being exposed to the Control Group of training. Four of the 15 subjects swam from .1 to .4 sec. faster after participating in the no-exercise group. Two of the swimmers had the exact times for both time trials.

A t ratio of 1.38 was obtained between the mean times of students when they were first timed and the mean times when they were finally timed after participating in the Weight Training Group. This t ratio indicated that there was no significant difference between the first timing and the last.

Twelve of the 15 swimmers swam from .4 to 2.9 sec. faster after participating in the weight training program. Three of the subjects swam from .6 to 4.0 sec. slower after being exposed to the weight exercises.

The swimmers in Swimming Group I swam 1.73 sec. faster after participating in this training program. A t ratio of 7.20 was obtained between the first performance scores and the final performance scores of this group of sub-

TABLE 1.—T RATIOS BETWEEN MEAN PERFORMANCE SCORES OF 81 SWIMMERS EXPOSED TO VARIOUS TRAINING PROGRAMS FOR SPEED OF SWIMMING 30-YARDS

No. of Subjects	Training Program		Time in Seconds				
			Group Mean	Standard Deviation	Standard Error of Mean	Pearson Product-Moment r	Critical Ratio
15	Control Group	Before After	18.47 18.75	2.80 3.03	.75 .81	.98	1.65[a]
15	Weight Training	Before After	20.20 19.62	2.49 3.15	.66 .84	.87	1.38[a]
13	Swimming Group I	Before After	18.62 16.89	1.65 1.51	.47 .43	.84	7.20[b]
13	Swimming & Weight Training	Before After	19.65 18.31	2.88 2.19	.83 .63	.83	2.85[c]
10	Swimming Group II	Before After	19.17 17.39	2.77 2.41	.92 .80	.92	4.81[b]
15	Swimming Group III	Before After	20.51 18.14	4.04 2.81	1.08 .75	.96	5.78[b]

[a]Not significant at the 5 percent level of confidence.
[b]Significant beyond the 1 percent level of confidence.
[c]Significant beyond the 2 percent level of confidence.

jects. This t ratio indicated that there was a significant difference between the initial performances and the final performances after participating in the swimming program three times weekly.

All 13 subjects swam from .2 to 3.4 sec. faster after they had participated in the program of Swimming Group I.

A t ratio of 2.85 was obtained between the first swimming scores and the final swimming scores of the Weight Training and Swimming Group. This t ratio was significant beyond the 2 percent level of confidence.

Ten of the subjects of the Weight Training and Swimming Group swam from .7 to 4.9 sec. faster after participating in this training routine. Three of the swimmers swam from .2 to .9 sec. slower.

A t ratio of 4.81 was obtained for the difference between the initial scores and the final scores of Swimming Group II. This t-ratio was significant beyond the 1 percent level of confidence. All ten subjects in the Swimming Group II swam from .4 of a second to 4.0 seconds faster after being exposed to this type of training program.

The mean time of the subjects in Swimming Group III was 2.37 seconds faster in the final time trials than the mean time in the first testing. The difference between the means had a t ratio of 5.78 which was statistically significant beyond the 1 percent level of confidence. All 15 subjects in

Swimming Group III swam from .9 of a second to 5.8 seconds faster after participating in this training routine.

It should be noted that all members of the groups who practiced only swimming gained in time while the other three groups had some subjects who lost in speed of swimming.

Summary and Conclusions

This study was conducted in order to determine the effects of various training programs on speed of swimming 30 yards. On the basis of this particular study, the following conclusions appear warranted.

1. Students who participated in absolutely no exercise did not improve in speed in swimming 30 yards.
2. The weight-training program employed three times per week in this study did not significantly improve group performance in speed swimming.
3. Swimmers who practiced starts, kicking for 150 yards, arm stroking for 150 yards, two 60-yard sprints at three-quarters speed and three 30-yard sprints at full speed three times per week significantly improved their performances in speed of swimming 30 yards. (This t ratio was significant beyond the 1 percent level of confidence.)
4. Subjects who swam six times weekly the same routine as cited in conclusion 3, above, showed a significant improvement in speed swimming.
5. Swimmers who practiced twelve 30-yard sprints and ten starts six times per week improved significantly in speed in swimming 30 yards.
6. Swimmers who did specific exercises with weights three times weekly and swam three times weekly improved significantly their performances in swimming.

References

1. Capen, Edward K. "The Effect of Systematic Weight Training on Power, Strength, and Endurance." *Research Quarterly* 21: 92; May 1950.
2. Chui, Edward. "The Effect of Systematic Weight Training on Athletic Power." *Research Quarterly* 21: 193-94; October 1950.
3. Davis, Jack F. "The Effect of Weight Training on Speed in Swimming." *The Physical Educator* XII: 28-29; March 1955.
4. Hairabedian, Ara. *The Effect of a Weight Training Program on the Speed of Running.* Master's Thesis. University Park: Pennsylvania State University, 1952.
5. Tominaga, Henry K. *The Effects of Weight Training upon Accuracy and Speed in Pitching Baseballs.* Master's thesis. University Park: Pennsylvania State University, 1954.
6. Wilkin, Bruce M. "The Effect of Systematic Weight Training on Speed of Movement." *Research Quarterly* 23: 361-69; October 1952.
7. Zorbas, William S., and Karpovich, Peter V. "The Effect of Weight Lifting Upon the Speed of Muscular Contraction." *Research Quarterly* 22: 145-48; May 1951.

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Recreational Interests of Undergraduate Men Physical Education Majors

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Abstract

A self-evaluation questionnaire test, constructed to determine the "breadth and depth" of their recreational interests and pursuits, was administered to the men undergraduate physical education majors at the University of Michigan. These men showed high interest and ability in physical recreational pursuits; fair interest and ability in social and communicative recreational interests; and relatively low interest in aesthetic, creative, and "learning" activities. It was urged that an effort be made to inculcate in them a sound philosophy of recreation.

DESPITE THE DIRE PREDICTIONS for our future because of the advent of the Space Age, it is possible that we are faced with an even greater danger —misuse of leisure. History shows that no civilization has survived for long when the people had too much free time. Automation will be with us to a greater extent with each passing year. How should this affect our recreational pursuits?

Can we develop a country where most people will find happiness and satisfaction despite the fact that many of us are crowded together in heavily populated cities and towns? To answer this question intelligently for ourselves and our families, we must ask what it is that a person should get out of life. Some would say pleasure, knowledge, and prestige; others would stress creativity, adventure, and sound health. A third group might wish for desirable personality traits, a religious faith, and the capacity to profit from a life-long education.

A large number of our communities have been surveyed to assess the status of their recreational programs. Consultants have been engaged to carry out these efforts. Various techniques of the survey method of research have been employed to find the answers to the many questions asked about the programs, facilities, areas, and leadership. There has been very little effort expended to determine specifically whether people's participation is broad in scope and varies from the passive through the active and creative levels.

Many people from all walks of life, together with a large number of professional people within the field of health, physical education, and recreation, hold the opinion that the average physical education graduate is fully qualified to undertake a position as a director of recreation.

Statement of the Problem

The problem was to determine the extent and range of the recreational interests of the undergraduate men physical education majors at the University of Michigan.

The hypothesis was that these young men would rate high insofar as their physical recreational interests were concerned and low in the areas of communicative, learning, and aesthetic and creative recreational interests. It was believed that they would score reasonably well in the area of social interests.

It is generally recognized that the better recreational leaders are individuals with a broad liberal arts and science background supplemented by sound professional preparation and an excellent field experience. Such leaders must possess a sound philosophy of recreation themselves and should guide people by example as well as precept.

Recreation for Community Living (1), the National Recreation Workshop report published in 1952, discusses the scope of recreation and how "man's need for it manifests itself in his search, day by day, for a full, happy life."

The following principles suggested in the report have been accepted for this study:

1. People have basic needs which motivate them to participate in the following types of recreational activities:
   a. Physical activity interests—tennis, golf, etc.
   b. Social interests—social clubs, etc.
   c. Communicative interests—writing, discussion, etc.
   d. Creative and aesthetic interests—painting, music, etc.
   e. Learning interest—educational hobbies.
2. There are roughly four levels of recreational "participation":
   a. Passive (e.g., watching television with slight interest)
   b. Emotional or vicarious (e.g., displaying marked identification with a term or an actor by showing increased interest)
   c. Active (e.g., regular, active engagement in sport or other activity)
   d. Creative (e.g., participation at high level of performance in any area of recreational interest).
3. There should be a balance between work and play in life.
4. Recreation is an "area of daily living."
5. "Recreation varies not only with the personality characteristics, needs, and environment of the participant but also with his exposure to recreational resources, his skill, and with his motivations."
6. "Recreation comes in many forms to different people and in different forms to the same people at different times."
7. As people progress through their lives, they have many needs which must be met for normal growth and development.
8. "The individual has a responsibility to use his leisure in a manner that improves him as a member of his community, state, and nation."
9. The individual must be free to choose how he spends his leisure.

Limitations of Problem

It is extremely difficult, perhaps impossible, to devise a test whereby people can determine exactly whether they are getting the most enjoyment possible

from their recreational pursuits. Requiring participation in certain activities would be negating a basic principle of recreation because of the destruction of the element of spontaneity. On the other hand, a "yardstick" may be of great help to people by pointing the way to a rich, full life replete with broad recreational interests.

Methodology

A questionnaire was devised whereby an individual could rate himself on the basis of his present recreational pursuits. This material went through a gradual process of refinement over a period of two years. The opinions of experts were sought. Several pilot projects were undertaken with undergraduate and graduate students. Finally the writer spent a period of time with a professional writer to refine still further the specific questions under each category prior to publication of the test (2). It was decided to submit the questionnaire to the undergraduate physical education majors at the University of Michigan. Appropriate descriptive statistics were then employed.

Results

Sixty-eight male physical education majors replied out of a possible total of 79 for a 86.7 percent return. The range of scores was from 14 to 43 with a possible top score of 50.

The mean (M) was 26.08, the median (Med) 25.10, and the mode (Mo) was 23.14. The standard deviation (σ) was 7.53, which means that 68.26 percent of the scores fell between plus 1 and minus 1 standard deviations (or between 18.55 and 33.61).

Under the specific areas of recreational interest the results were as follows:

Area of Interest	*Mean* (of a possible 10)
1. Physical interest	9.6
2. Social interest	5.8
3. Communicative interest	4.5
4. Creative and aesthetic interest	2.8
5. Learning interest	3.2

A test of deviation from the normal curve was used to determine how "normal" the obtained frequency was. The graphic test of normality was used. A frequency polygon was prepared to plot the distribution exactly. The normal curve was then obtained from the obtained frequency distribution. These were placed, or superimposed, on the same graph. It was decided that the distribution varied too greatly from the normal curve to be considered an average group. The distribution was not skewed to the right or left, but the top of the distribution appeared to be too high in relationship to the normal curve.

Summary and Conclusions

A self-evaluation questionnaire test was administered to the men undergraduate physical education majors at the University of Michigan to determine the "breadth and depth" of their recreational interests. An 86 percent

return was obtained which showed a high rating in physical recreational interests, a fair rating in social and communicative recreational interests, and a poor rating in aesthetic, creative, and learning recreational interests. On the other hand, according to the rating scale suggested for use upon completion of the tests, they rated at the bottom of the above-average group. This score would indicate a reasonably good achievement of a balance between work and play in their lives.

The following conclusions may reasonably be drawn from this study:

1. Male physical education major students at the University of Michigan show high interest and ability in physical recreational interests and low interest (and perhaps ability) in aesthetic, creative, and learning recreational pursuits. They scored quite well (5.8) in social interests and only fairly well (4.5) in communicative interests.
2. If these particular male physical education majors hope to assume positions as directors of recreation, it is imperative that an effort be made to inculcate in them a sound philosophy of recreation.

Recommendations for Further Study

1. Further tests of this type should be administered to physical education major students in other universities to test these results.
2. It would be interesting to determine to what extent male recreation majors differed in their recreational interests and pursuits.
3. A similar test administered to women undergraduate physical education majors would make an interesting comparison.
4. If this test were administered to a reliable random sampling of families in a community undergoing a recreation survey, it could serve as a valuable adjunct to other survey techniques employed.

References

1. National Recreation Workshop. *Recreation for Community Living.* Chicago: The Athletic Institute, 1952. 167 p.
2. Zeigler, E. F. "How Do You Rate Yourself Recreationally?" *Parade.* February 23, 1958.

Appendix

HOW DO YOU RATE YOURSELF RECREATIONALLY?
(A Test for Self-Evaluation)

Instructions:

Give yourself *one* point if you answer "yes" to question #1 under sports recreational interests. In like manner give yourself *two* points for answering question #2, *three* points for question #3, and *four* points for #4. At the bottom of each section total your score from each of the four questions in that section. When you have completed all the questions in the five categories, total the scores from the different categories. Rate yourself according to the scale for grand total, and according to the scale for individual sections.

I. *Sports* (e.g., tennis, golf, or other sports)

1. Do you regularly glance through the sports section of your local newspaper?
Check yes ( ) or no ( ) Score______

2. Are you a faithful follower of at least one team or athlete rejoicing in victory and fretting in defeat?
yes ( ) or no ( ) Score______
3. Do you take part two or three times a week throughout the entire year in one or more active games or sports?
yes ( ) or no ( ) Score______
4. Are you considered one of the better players in any active game or sport among opponents your own age?
yes ( ) or no ( ) Score______

Total Score for this Section ______

Scale

10 pts. — superior
6 pts. — good
3 pts. — fair
1 pt. — poor

II. *Social* (e.g., social club, family recreation, etc.)
1. Do you make nodding acquaintances with a number of people?
yes ( ) or no ( ) Score______
2. Do you take an interest in and attend at least one social organization or club?
yes ( ) or no ( ) Score______
3. Do you invite friends in for dinner (or invite someone out) at least once a month?
yes ( ) or no ( ) Score______
4. In the past year have you been elected an officer or named as a committee chairman of a club or social organization?
yes ( ) or no ( ) Score______

Total Score for this Section ______
(see scale under *Sports*)

III. *Communicative* (writing or speaking) (e.g., discussion group, article writing, etc.)
1. Do you phone or drop in on a friend regularly just to pass the time of day?
yes ( ) or no ( ) Score______
2. Do you stick up for a point of view even though it may mean a difference of opinion with a close friend?
yes ( ) or no ( ) Score______
3. Have you in the past six months written one or more letters strongly expressing your opinion to an editor, school principal, or civic official?
yes ( ) or no ( ) Score______
4. In the past six months have you given a talk or led a discussion at your PTA, church, or any other local group?
yes ( ) or no ( ) Score______

Total Score for this Section ______
(see scale under *Sports*)

IV. *Aesthetic and Creative* ("Cultural") (e.g., oil painting, music, sculpturing, etc.)
1. Do you like to listen to a musical concert on the radio or watch a dramatic play on television?
yes ( ) or no ( ) Score______
2. Have you attended at least three or four concerts, plays, or art exhibits in the past year?
yes ( ) or no ( ) Score______
3. Do you paint, sketch, play an instrument, or sing, etc. regularly?
yes ( ) or no ( ) Score______
4. If your answer to #3 was "yes", do you rate yourself high enough to enter a contest or competition?
yes ( ) or no ( ) Score______

Total Score for this Section ______
(see scale under *Sports*)

V. ***Hobbies*** **(Educational) (e.g., astronomy, coin-collecting, bird watching, etc.)**

1. Do you like to hear or read about the hobbies of others?
   yes ( ) or no ( ) Score______
2. Are you so interested and knowledgeable in any educational hobby (not necessarily one in which you actively take part yourself) that you could discuss it intelligently with an expert on that subject?
   yes ( ) or no ( ) Score______
3. Do you have an educational hobby of your own?
   yes ( ) or no ( ) Score______
4. Are you considered an expert on your hobby, possibly having won an award in the past year or two?
   yes ( ) or no ( ) Score______

Total Score for this Section ______
(see scale under *Sports*)

Now add your totals for each category to get your final score.

FINAL SCORE ______

Rate yourself according to the following scale:

50-35 pts.—*Outstanding*—You are getting too much fun out of life. How about doing some work for a change?

34-24 pts.—*Above Average*—You have achieved a balance between work and play. You can enjoy your fun without having a guilty conscience.

23-14 pts.—*Average*—Your score indicates a fair status. You may be one-sided, or you may not have enough depth at anything.

13-6 pts.— *Below Average*—You are missing some of the good things and fun that life has to offer.

5-0 pts.— *Poor*—Life is probably a tedious routine for you. Wake up and live!

(Submitted 1/24/59)

CORRECTION

There is an error in the placement of the figures in the article by Ernest D. Michael and Arthur Gallon, "Periodic Changes in the Circulation During Athletic Training as Reflected by a Step Test," in the October 1959 RESEARCH QUARTERLY, p. 303–11. The captions are in the correct locations, but the figures should be transposed (Figure I should appear on p. 305 instead of on p. 306, and Figure II should appear on p. 306 instead of on p. 305). We apologize to the authors for this error in the October issue.—*Ed.*

Research Abstracts

Prepared by the Research Abstracts Committee of the Research Council, D. B. VAN DALEN, Chairman

78. ÅSTRAND, IRMA; ÅSTRAND, PER-OLOF; and RADAHL, KAARA. "Maximal Heart Rate During Work in Older Men." *Journal of Applied Physiology* 14: 562-66; July 1959.

Nine male subjects 56–68 years old performed muscular work up to maximal loads on a bicycle ergometer while breathing ambient air and again while breathing pure oxygen. Heart rates increased to an average maximum of 163/min. Maximum O_2 intake averaged 2.24 L/min. and the highest concentration of blood lactic acid averaged 85 mg/100 ml. Breathing pure O_2 while exercising did not increase the maximum heart rate. The authors suggest that the low maximal heart rate limits O_2 intake in older subjects. Four subjects were able to work for about one hour without becoming exhausted on a work load requiring an O_2 consumption of about 50 percent of their maximal aerobic work capacity.—*Clifford E. Keeney.*

79. BARRUETO, RICHARD B.; MAGER, MILTON; and BASS, DAVID E. "Measurements of Rates of Excretion of Sweat Solutes under Physiological Conditions." *Journal of Applied Physiology* 14: 435–38; May 1959.

This report describes an apparatus which permits measurement of excretion rates of sweat solutes from an arm, and which permits control of skin temperatures independent of the environment. This device collects from an arm all sweat solutes separately from the associated water by isolating an arm in a thermoregulated copper cylinder constructed to allow air to diffuse evenly as it enters the chamber. Sweat water is collected in a trap system and the solutes are subsequently washed from the arm and analyzed.

In this validifying study, the skin temperature of the enclosed arm was maintained as that of the control arm and temperatures were measured continuously. After exposure, solutes were collected from both arms and analyzed for sodium, potassium, chloride, "apparent" creatinine, and urea. There was little difference between arms in the mean rate of excretion of solutes measured. It was concluded that this is a valid apparatus for studying the effects of various environments on the several solutes measured.—*Carl S. Blyth.*

80. BEECHER, HENRY, and SMITH, GENE. "Amphetamine Sulfate and Athletic Performance." *Journal of the American Medical Association* 170: 542; May 1959.

This study consisted of two parts. During the first part, 7 mg. of amphetamine per 70 kg. of body weight was given 1 to 2½ hours before the test. During the second part, 14 mg. of drug were given 2 to 3 hrs. before the test. During the first part 11 out of 14 swimmers and 2 out of 6 runners improved their times with amphetamine. During the second part, 18 swimmers, 26 runners, and 13 weight throwers were used in 781 tests. The ergogenic effect of amphetamine was statistically significant for all activities: 67 to 93 percent of swimmers, 73 percent of runners, and 85 percent of weight throwers performed better with amphetamine than with a placebo.—*P. V. Karpovich.*

81. BENDIG, A. W., and STILLMAN, EUGENIA L. "Curricular Differences in Job Incentive Dimensions among College Students." *Journal of Educational Psychology* 49: 250; October 1958.

The purpose of this study was threefold: (a) identify, on an a priori basis, curricular subgroups of subjects, (b) combine these subgroups into major curriculum groupings

by means of an empirical factor analysis of their subgroup profiles in ranking job incentives, and (c) test whether there were major curriculum groupings on the derived factor scores. A form listing eight incentives was administered to 267 undergraduates (divided into eleven subgroups on basis of sex and college curriculum). The subjects were then requested to rank the incentives in order of importance. A factor analysis of the subgroup incentive profiles isolated three factors ("masculinity," "tenderminded social vs. toughminded practical," and "interest in science and technology") and condensed the eleven subgroups into six major curriculum groupings on the basis of the subgroup patterns of factor loadings. Scores on three factors isolated in a previous factor analysis of the incentives were computed for individual subjects and significant differences were found among the six factor pattern groups for all three factor scores.—*D. B. Van Dalen.*

82. Brozek, Josef, and Mori, Hiroyoshi. "Some Interrelations between Somatic Roentgenographic and Densitometric Criteria of Fatness." *Human Biology* 30: 322; December 1958.

Data were provided for the empirical appraisal of the value of absolute thickness vs. thickness related to various criteria of body size. The subjects were 52 middle-aged business and professional men averaging 57 years in age. The coefficient of correlation between skinfold measurements at the dorsum of the upper arm and the corresponding roentgenogrammetric value was 0.82. The average skinfold value, obtained with the pressure of 10 gm/mm^2 of the contact surface of the caliper, corresponded to 82 percent of the doubled width measured on the roentgenograms. Equations for predicting body density were calculated for single sites and for combined lateral-plus-medial or ventral-plus-dorsal roentgenographic measurements. Available evidence indicated measurements made on roentgenograms of the extremities do not appear to be more effective indicators of leanness-fatness than direct skinfold measurements.—*D. B. Van Dalen.*

83. Doudoumopoulos, Alexander N., and Chatfield, Paul O. "Effects of Temperature on Function of Mammalian (Rat) Muscle." *American Journal of Physiology* 196: 1197–99; June 1959.

The effects of local cooling on mammalian muscle were studied. The temperature of rat gastrocnemius was lowered in steps from 37°C to 26°C to 18°C and finally to 9.5°C. The sciatic nerve was stimulated at rates of 1, 10, 15, 20, 30, 50, and 60 shocks per second. The stimulation was then repeated at each new temperature. Then the muscle was rewarmed to 37°C and the animal curarized, and the muscle was stimulated directly at the same frequency as the temperature was lowered by the same increments as before described.

By varying muscle temperature and stimulus frequency, reproducible curves relating to the amount of tension developed as a function of temperature at any given stimulus frequency were obtained. The results were the same on both direct and indirect stimulation. This would indicate that the effects of temperature at the neuromuscular junction were not the critical elements in the phenomena observed.

The authors point out that their rather unexpected observations suggest that perhaps in such diseases as myasthenia gravis it would be profitable to re-examine the role of the neuromuscular junction as contrasted with a possible primary disorder of the contractile mechanism.—*Carl S. Blyth.*

84. Durnin, J. V. G. A. "The Use of Surface Area and of Body Weight as Standards of Reference in Studies on Human Energy Expenditure." *British Journal of Nutrition* 13: 68–71; 1959.

Individual measurements of the energy expenditure of about 160 adult subjects were used to compare gross body-weight and surface area as standards of reference for energy expenditure. M^{2}BSA was calculated from the DuBois formula. The multiple regression analysis showed quite clearly that there was no purpose in using surface area rather

than weight. Both appear equally useful, but weight is easily and accurately measured, whereas M^2BSA is calculated and the error may be considerable.

Fat free body mass is of dubious value in metabolic studies. The methods for its determination are of unknown accuracy and body fat cannot be ignored in connection with measurements of energy expenditure.

The use of any unit of reference implies a fundamental biological error, since it infers that the (straight) regression line passes through the origin. A (straight) regression line may fit the data adequately, but if this line does not pass through the origin (which generally it will not do) the use of a ratio correction is not justified.

Very few activities are carried out at a steady rate over a long period. It would therefore appear logical to express results as Cal./min. It has been common to give energy expenditure in net Cal., with a deduction for BMR. The BMR is usually taken from tables, which may introduce a considerable error. It appears illogical to make a deduction which, for any activity involving exercise, will be very small and of unknown accuracy.—*Philip J. Rasch.*

85. Essman, Walter B. "'Learning without Awareness' of Responses to Perceptual and Verbal Stimuli as a Function of Reinforcement Schedule." *Perceptual and Motor Skills* 9: 15; March 1959.

Sixty college freshman and sophomores (20 males and 40 females) from an introductory psychology class were selected as subjects. These 60 subjects were randomly divided into three experimental groups. Each group was shown perceptual and verbal stimuli which were to be assigned to one of four (Human, Animal, Anatomical, or Botanical) response classes suggested by the experimentor. The subjects operated under three conditions of reinforcement ranging from no reinforcement, to total reinforcement, to partial (50%) reinforcement. The reinforcement consisted of the experimenter saying "good" following a criterion response.

After predetermined number of acquisition trials, reinforcement was stopped although trials continued. During the acquisition trials, the reinforced groups showed a significant increase in response frequency. After reinforcement stopped, there appeared significant differences in the response frequency of various groups.

This result supported the hypotheses that learning without awareness occurs when perceptual as well as verbal stimuli are employed, and that resistance to extinction of responses learned without awareness is a function of the reinforcement schedule maintained during acquisition.—*D. B. Van Dalen.*

86. Garn, Stanley M. "Fat, Body Size, and Growth in the Newborn." *Human Biology* 30: 265; December 1958.

This investigation was based primarily upon roentgenogrammetric and anthropometric measurements of 146 developmentally-mature Ohio-born white neonates, and 95 mothers from southwestern Ohio. The relationship to maternal size, gestation length, body size, and long-bone length were studied. There was no sex difference in the thickness of fat, however the fat/weight ratio for the female neonates was significantly higher than in the male. Fat thickness at birth was not significantly related to maternal size, weight gain, or length of gestation. Fatter babies were longer overall and thus tended to weigh more. Those neonates who were fatter at birth, tended to be fatter and longer during the first few months of postnatal life, but gained less weight during early extra uterine existence. Analysis of fat weight data on a series of nine diabetic progeny revealed that diabetic infants were extremely fat, exceptionally so in relation to their weight. These findings indicated that subcutaneous fat could be investigated roentgenogrammetrically at the earliest age levels, and with anticipation of useful findings on the fat compartment and its implications in terms of late prenatal development.—*D. B. Van Dalen.*

87. Guilford, J. P. "A System of Psychomotor Abilities." *American Journal of Psychology* 66: 164–74; March 1958.

Known psychomotor factors include strength, impulsion (rate at which movements are initiated from a stationary position), speed (rate of movements after they have started), static precision, dynamic precision, coordination, and flexibility. The first two seem to be general factors; the others appear to represent simultaneous involvement of two or more regions. Possibly the former are more dependent on heredity and the latter on experience, but this possibility should not be stressed too much. Undiscovered primary psychomotor abilities may include muscular endurance, circulatory-respiratory endurance, agility, and power, but these may be syndromes of physiological characteristics. Studies are needed of the intercorrelations between anatomical and physiological traits. The properties of bone and muscle, and the manner in which they are put together should have much explanatory significance in accounting for many psychomotor abilities. Neurological parts and properties may account for many of the observed distinctions.—*Philip S. Rasch.*

88. Guyton, Arthur C., and others. "Relative Importance of Venous and Arterial Resistance in Controlling Venous Return and Cardiac Output." *American Journal of Physiology* 196: 1008–14; May 1959.

The relative importance of venous and arterial resistances in controlling venous return and cardiac output was determined in dogs whose cardiovascular reflexes had been blocked by total spinal anesthesia. Small plastic microspheres were injected into the arteries to increase arterial resistance. Pneumatic cuffs were inflated around the major veins to increase venous resistance. Total peripheral resistance was thereby increased in two ways by the methods mentioned above.

Though the changes in total peripheral resistance were equal in the two studies, the effects on cardiac output were vastly different. Small increases in venous resistance diminished cardiac output eight times as much as similar increases in arterial resistance. The authors conclude that the results of these studies help to explain many hitherto poorly understood observations on venous blood flow. This analytical approach shows that in normal operation of the circulatory system venous resistance is extremely important as a determinant of cardiac output while arterial resistance has relatively little significance.—*Carl S. Blyth.*

89. Hanman, Bert. "Climbing Up Stairs." *Industrial Medicine & Surgery* 28: 67–68; February 1959.

Many persons believe that they climb stairs for a much longer time each day than is actually true. Because of this belief it is probable that many individuals with medical restrictions on their climbing could safely climb considerably more than they do. Several hundred climbers in Boston subways and buildings were timed. The rate climbed by 81 percent of the subway climbers was two steps per second, regardless of the variations in the height of the steps in the various stations. In actual climbing time, 120 flights of 15 steps per flight could be climbed in 15 minutes of average climbing. It is likely that people do not climb stairs nearly as much as they believe they do.—*Philip J. Rasch.*

90. Janowitz, Henry D. "Hunger and Appetite: Physiological Regulation of Food Intake." *American Journal of Medicine* 25: 327–31; September 1958.

The physiologic mechanism which regulates caloric intake is both complex and subtle. Only an incomplete account can be given of its nature. What it regulates is probably the body's store (excesses or deficits) of nutritional elements. It is a function of the hypothalamic centers to inhibit or facilitate certain feeding sensations. Stimulation of the oropharyngeal receptors associated with tasting, chewing, and swallowing food contribute to controlling the amount of food ingested by inducing temporary satiety.

Gastric distention reinforces the inhibitory effect of the volume of food ingested on subsequent intake. Gastrointestinal metering is probably operative only in short-term regulation; the metabolic consequences are probably to be sought in long-term regulation. Among the factors involved may be the body's store of water, changes in water concentration, biochemical changes in the hypothalamus, thermal stress, glucose utilization, fat depots, and levels of metabolites in the blood. From the standpoint of energy-exchange, it may be the extra heat released by the assimilation of food (specific dynamic action) and not the calories per se which are measured. Only a multiple factor analysis can do justice to the problem. Variabilities in the functioning of this regulating equipment may be responsible for certain types of "regulatory" obesity. Food-taking is a homeostatic mechanism worthy of being studied in itself along with the other physiologic regulations of the body.—*Philip J. Rasch.*

91. Karpovich, Peter V. "Effect of Amphetamine Sulfate on Athletic Performance." *Journal of the American Medical Association* 170: 558–61; May 1959.

Fifty-four subjects were given doses of 10 and 20 mg. of amphetamine sulfate either one hour or 30 minutes before participating in the experimental tests. Fifty subjects showed neither beneficial nor deleterious effects from the injestion of amphetamines. Three of the remaining four subjects demonstrated improvement in performance and one subject was affected deleteriously. All subjects were male college students. The tests were conducted in swimming, track, and treadmill running. The drugs and the placebos were given the athletes orally and the double blind technique of drug administration was used.—*Carl S. Blyth.*

92. Kleiman, Aaron H. "Hematuria in Boxers." *Journal of the American Medical Association* 168: 1633–40; November 1958.

A three-year study of 764 professional boxers indicated that boxing hematuria is usually traumatic and mechanical in origin. The incidence of significant hematuria was twice as high in white as in nonwhite puglists. Increased time in the ring increased the tendency toward significant hematuria. The kidney disorders most frequently diagnosed were hydronephrosis and movable kidney, none of whch required surgical intervention. Excessive mobility occurred three times as frequently in white as in nonwhite boxers. Boxing trauma may result in rupture of the veins about the renal papillae or pyramids. The resulting hemorrhage may cause intercapillary compression about the nephrons. Later a clot may form, with proliferation of connective tissue. An area of scar tissue results, producing the characteristic pericalyceal deformities of "athletic kidney." Although these changes appear to be permanent, only mild impairment of renal concentration power was shown.—*Philip J. Rasch.*

93. Logan, George B. "Essential Medical Supervision in Athletics for Children." *Journal of the Medical Association* 169: 786–88; February 21, 1959.

Essential medical supervision of children in sports consists of making sure that the child is fit to compete and in seeing that he remains fit during the period of participation. Tests of physiological maturity, coordination, and conditioning are of value, even though not highly accurate There is little factual material on the injury rate of children engaged in various sports. Data collected on participants in the Pop Warner Football League indicate that most of the severe injuries are fractures or epiphysial separations. Medical supervision should be available during practice sessions as well as during games.—*Philip J. Rasch.*

94. Marsk, Axel. "Studies on Weight-Distribution Upon the Lower Extremeties in Individuals Working in a Standing Position." *Acta Orthopaedica Scandinavica* Supplementum No. XXXI, Vol. 27, 1958.

An equal loading of the two feet would demand a symmetrical arrangement of the two halves of the body around a vertical projection of the center of gravity. It is

obvious that this condition is seldom realized. Those working with the right hand tend to place the greater portion of the weight on the left foot. This crossed adjustment arm-leg results from the fact that basic principles of statics and dynamics act in favor of using the contra-lateral leg as the standing-leg. The most stable equilibrium is achieved by a crossed, diagonal adjustment of forces.—*Philip J. Rasch.*

95. MONTOYE, HENRY J., and others. "The Effects of Exercise on Blood Cholesterol in Middle-Aged Men." *American Journal of Clinical Nutrition* 7: 139–45; March–April 1959.

Thirty-one male faculty members at Michigan State University were divided into a control group and an exercise group. The exercise program consisted of supervised calisthenics and swimming. No significant blood serum cholesterol changes were found in mean initial or final values among "n[illegible] subjects in either group, although one "high" cholesterol subject in the exercise gr[illegible] showed a decrease significant at the 5 percent level. Changes in serum cholesterol generally accompanied a change in body weight, regardless of exercise.—*Philip J. Rasch.*

96. MULLER, E. A. "Training Muscle Strength." *Ergonomics* 2: 216–22; February 1959.

Muscular strength and muscle fiber-mass are strictly correlated. To keep up an unnecessarily large muscle mass is costly in metabolism and circulatory effect. The stimulus necessary for an increase of muscle strength is an increase in tension over that previously exerted. In progressive training procedures the stimulus is kept above the critical level by increase in proportion to the increase in maximum strength. The maximal rate of increase can be achieved with one single muscle contraction per day; with a one-week interval between contractions strength increases at about one-third of the speed found with a one-day interval. Very little activity is necessary to prevent the loss of contractile power. Permanent increases in muscle strength may be obtained by long-interval training or by short-interval training followed by maintenance of the trained state. It may be assumed that short-interval training increases the cross-section of the muscle fibers, whereas in long-interval training the fibers multiply and more connective tissue is produced inside the muscle per unit of cross section. The rate of strength increase is not the same for different muscles of the same person nor for those of different sexes or ages. It is not known whether there is a correlation between speed of strength increases and the endpoint to which increase is possible. Increase of strength can be prevented by a low protein intake but cannot be speeded up by a high protein intake.—*Philip J. Rasch.*

97. National Society for Crippled Children and Adults, Inc. *Easter Seal Research Foundation, A Report.* 1959.

Progress being made in searching out causes and means of alleviation of crippling conditions is discussed in the above report of the work being done under grants of the Easter Seal Research Foundation.—*D. B. Van Dalen.*

98. OPPENHEIMER, MORTON J., and others. "Physiological Effects of Carbon Dioxide Gas Introduced into Coronary Arteries." *American Journal of Physiology* 196: 1308–11; June 1959.

The authors studied the electrocardiographic and blood pressure responses of anesthetized dogs when carbon dioxide gas was introduced into the coronary arteries. The presence of the carbon dioxide gas was well tolerated when introduced directly into the coronary arteries. Apparently the injected gas goes into solution immediately. There were no fatalities in either normal or freshly infarcted hearts. Rapid injection of the carbon dioxide gas caused extrasystoles and some subsequent changes of short duration of the electrocardiogram. The authors attempted to assess the dangers which may exist when carbon dioxide gas enters coronary arteries of both normal and freshly infarcted hearts. In conclusion, the authors state that under the conditions of their experiment,

carbon dioxide gas does not appear to cause any long lasting damage if the electrocardiogram and blood pressure are selected as criteria.—*Carl S. Blyth.*

99. POMRINSE, S. DAVID. "Marginal Man: a Concept of the Aging Process." *Geriatrics* 13: 765-66; November 1958.

Aging is a progressive reduction of reserves, and an aged person is one whose reserves have been reduced to the point where he is approaching the margin between independence and dependence. He is, therefore, more likely to be thrust over the margin by stress and trauma than is the younger person and is thus in greater need of supportive measures during periods of stress. What are needed are (1) intensified research aimed at measuring reduction of reserves, and (2) intensified application of preventive measures. Marginal persons are not fully participant in the group. Aging includes physiologic, psychologic, and social changes. The goal of treatment is to help re-establish sufficient resources so that the patient can function by himself. Help from a group of therapists is probably the most realistic approach. Many older persons capable of and willing to work are forced to retire. To avoid unnecessary and wasteful removal of such persons from society the older person must be paced by his ability to function.—*Philip J. Rasch.*

100. REDISH, W., and others. "Vasomotor Responses to Exercise in the Extremities of Subjects with Vascular Disease." *Circulation* 19: 579; April 1959.

The response of peripheral blood flow to exercise was studied in 12 young healthy adults, 16 elderly persons without vascular disease, and 12 patients with arteriosclerosis, 5 having had lower extremity sympathectomy. The basal flows were higher in the young healthy adults than in the elderly healthy persons. They were lowest with the arteriosclerosis patients without having had sympathectomy. After exercise all groups increased total blood flow.

In the young healthy adults somewhat more blood goes to the muscle than the skin; in the healthy elderly, the reverse is true. In patients with arteriosclerosis, the distribution is about equal unless sympathectomy has been performed, then the skin receives a greater share. The distribution was not altered by exercise and an increase in total blood flow.—*E. D. Michael.*

101. SAFAR, PETER. "Failure of Manual Respiration." *Journal of Applied Physiology* 14 84-88; January 1959.

Twenty-nine adults acted as subjects in this study in which data are presented on tidal volumes moved with the conventional back-pressure armlift method (BPAL), a modified BPAL method, the conventional chest-pressure arm-lift method (CPAL), and a modified CPAL method. Each subject was given sufficient anesthesia to maintain unconsciousness from thirty minutes to three hours. Tidal volumes during manual respiration were measured by a spirometer; 18 experienced male rescuscitators performed the several methods.

The results indicate that the modified CPAL method provides better ventilation and less airway obstruction than the other methods tested, because it maintains a better "chin-up" position. The conventional BPAL method should be the last choice if ventilation is used as the criterion. The chief reason for failure of manual methods to do an adequate job of rescuscitation is pharyngeal obstruction by the relaxed tongue. The authors point out that recent studies have demonstrated that mouth-to-mouth methods maintain better pulmonary ventilation than any method which relies on compression and expansion of the chest. —*Carl S. Blyth.*

102. SCHERR, MERLE S. "Physical Conditioning Program for Asthmatic Children." *Journal of the American Medical Association* 168: 1996-2000; December 13, 1958

When physical exercise is forbidden, asthmatic children may develop a loss of the initiative and confidence necessary for personality adjustment to life. The Charleston,

West Virginia, YMCA offers the asthmatic child a program incorporating both breathing exercises and physical activity. Emphasis is placed on diaphragmatic breathing, costal breathing, and asymmetrical breathing, as recommended by the Asthma Research Council, London. Postural exercises are done between breathing exercises. Gymnastics are performed under supervision. Combative training designed to increase self-confidence is given those with kinesiological skills. With few exceptions, children showed improvement in school, home, and church activities, a lessening of the frequency and severity of asthmatic attacks, and a definite emotional adjustment improvement.—*Philip J. Rasch.*

103. Shaklee, Alfred B., and Jones, B. Edson. "Problems of Method and Theory in Controlling Rest Activity." *Journal of General Psychology* 60: 11–16; January 1959.

The authors discuss the problems involved in trying to control activity during rest periods in learning experiments. A rest period is not actually a "behavioral vacuum" as is often assumed. The authors suggest that we should admit out inadequacy to prevent certain variables from operating between learning trials. They also suggest the use of such tools as EEG tracings to better describe what actually might occur during rest periods.—*Bruce L. Bennett.*

104. Siegel, Alberta Enguall, and Kahn, Lynette Gayle. "Permissiveness, Permission, and Agression: the Effect of Adult Presence or Absence on Agression in Children's Play." *Child Development* 30: 131; March 1959.

The hypothesis of this study was that children will exhibit different, session-to-session changes in aggression, in that the aggression of children under adult-absent conditions will tend to decrease in comparison to the aggression of the children under the adult-present condition, which will tend to increase. The subjects were 18 pairs of boys from a university nursery school. Each pair was composed of one boy from the oldest 50 percent (4 yr.-1 mo. to 5 yr.) and one from the younger set (2 yr.-11 mo. to 4 yr.-9 mo) The subjects were observed in two sessions separated by two days. The aggression of the older member of each pair was scored. Half of the pairs' play sessions were in the presence of a permissive adult, and half were in the absence of any adult. Two-thirds of the subjects in the adult-present sessions were more aggressive in the second than in the first session and all the subjects in the adult-absent sessions were less aggressive in the second than in the first session. The hypothesis was confirmed.—*D. B. Van Dalen.*

105. Sloan, A. W., and Keen, E. N. "Physical Fitness of Oarsmen and Rugby Players Before and After Training." *Journal of Applied Physiology* 14: 635–36; July 1959.

The effect of systematic training on resting pulse rate and Harvard step test fitness index scores of groups of oarsmen and rugby players was tested. Thirty-five oarsmen, 45 rugby players, and 20 medical students (control group) were used in the experiment.

The mean resting pulse rates of the three groups were not significantly different at the time of the first trial, but after training, the oarsmen and rugby players had a significantly lower mean pulse rate than did the untrained control group. The athletes had significantly higher fitness scores than did the nonathletes at the first trial, and this group also demonstrated a significant increase in fitness index after training, while the nonathletes who underwent no training failed to show a significant change in fitness index. The lowered resting pulse rate demonstrated by the athletes was not significantly greater than that which took place in the control group, but the rise in fitness index which took place in the athletic groups was significantly greater than that which took place in the untrained group. There was no significant difference in any aspect of the experiment between oarsmen and rugby players.

The authors concluded that a high fitness index is a more reliable criterion of physical fitness than is a low resting heart rate, because the index is less subject to extraneous factors and more closely related to the capacity for strenuous exertion.—*Carl S. Blyth.*

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